USIGS Geospatial Transition Plan

AUGUST 2001

Foreword

Transformation of the Department of Defense and the Intelligence Community is predicated on achieving information and decision superiority. Immediate access to fused, accurate, and relevant information to aid in strategic and tactical decision making is a lofty goal – lofty, yet achievable. No capability is more important than situational knowledge shared among all elements of the joint force. This shared situational knowledge – the Common Relevant Operational Picture (CROP) – provides the foundation for new capabilities.

Achieving the CROP requires a modernized United States Imagery and Geospatial Information Service (USIGS) – one of the most complex national security challenges of the 21st century – one we are meeting head-on. This USIGS Geospatial Transition Plan, when fully funded and implemented, will deliver a trusted framework of geospatial information that will serve as the common frame of reference for the CROP – the ground truth which is the prerequisite to interoperability. This trusted framework will provide not only the operational foundation for visualizing the CROP but also the needed ability to accurately reference information from other providers. It will also provide the geospatial information and intelligence needed to generate knowledge about the mission space and actionable advice needed to achieve information and decision superiority.

Let me extend my personal and sincere thanks to the many men and women from across the Services, Agencies, and Unified Commands who contributed to this document. They have done a superb job of working through some very contentious and complex technical issues. Thanks to their collective efforts I have every confidence that the plan is valid, attainable, and absolutely the right thing to do.

Make no mistake – the completion of this document only marks the beginning of our quest. The real work is still ahead in implementing this plan. To ensure its implementation, I have funded the implementing initiatives to the maximum extent possible through the USIGS Rebaselining Activity and the Fiscal Year 2003-2007 Program Objective Memorandum/Intelligence Program Objective Memorandum (POM/IPOM). My senior leaders are equally committed and are giving this plan their personal attention from both planning and operational perspectives.

NIMA will immediately begin integrating the plan's content into the higher order USIGS documents and Agency business plans which will provide additional opportunities for critical discussion. We must pay careful attention to the sequence and timing of events to ensure a smooth transition across the USIGS. Considerable work needs to be done to build the infrastructure, acquire and/or produce the data, and develop the geospatial information-based analytical skills required throughout the USIGS. We must accomplish these objectives while continuing to maintain our geospatial readiness against today's missions.

I solicit your personal support as well. This is not NIMA's plan alone – it is USIGS' plan, and success requires our dedicated attention. As we implement this plan, we must

continuously keep each other informed of our progress. Working together we will meet the challenges of information and decision superiority in the new millennium.

JAMES C. KING
Lieutenant General, USA

USIGS Geospatial Transition Plan

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Executive Summary

In August 2000, LTG James C. King chartered the Geospatial Information Infrastructure Implementation Integrated Product Team. The charter of the team has been to prepare the geospatial domain of the United States Imagery and Geospatial Information Service (USIGS) for the 21st Century's transformation. A vital step in this transformation is this USIGS Geospatial Transition Plan (USIGS GTP).

This USIGS GTP provides the geospatial information vision, a concept of operations for 2010, and the implementation master plan for Fiscal Years 03-07. When fully funded and implemented, the plan provides the basis for improving our global readiness as well as our ability to respond in times of crisis with interoperable information that is more current, accurate, and relevant. It also delivers the digital infrastructure needed to manage and provide rapid, intelligent access to the geospatial information holdings of the USIGS. Finally, it will provide the education and training opportunities needed to leverage these new capabilities for the Common Relevant Operational Picture and contribute significantly to the goals of achieving information and decision superiority.

Transformation and the Need for Change. The realities of global politics, transformation in the Department of Defense, and the role of change in commercial technology are such that we must prepare for a leap-ahead capability within USIGS to better meet the requirements of this new century. The USIGS can no longer produce and operate solely with legacy hardcopy mapping and charting products. We must work together to transform our plans, programs, and operations to reflect this needed change. At the end of Fiscal Year 03, NIMA will begin terminating production of products based on time-honored standard hardcopy methods. By Fiscal Year 05, NIMA will have fully transitioned to becoming more of an information service provider, focusing on acquiring, generating, and disseminating digital geospatial information capable of supporting the visualization and analytical requirements of the USIGS. These views will include standard two-dimensional representations found in hardcopy products today as well as three- and four-dimensional views of the mission space required by tomorrow's systems. Key elements of the planned transformation are:

1. Implement a readiness and responsiveness strategy for geospatial information that supports NIMA's efforts to integrate its mission areas and provides the ability to accurately position other spatially referenced information on the earth,
2. In collaboration with our international, national, and commercial mission partners, accelerate population of the trusted geospatial framework by automating and acquiring what we can and producing only what we must,
3. Transition to an information service provider, with greater emphasis on delivering rapid, intelligent access and the analytical expertise needed to fully exploit the power of digital geospatial information,
4. With private industry, establish the digital infrastructure, processes, and capabilities to integrate imagery, imagery intelligence, and geospatial information,
5. Leverage advanced technology to exploit new sources of geospatial information,
6. Strengthen NIMA's role as the USIGS Functional Manager,
7. Provide needed training and education opportunities, and

8. Identify the resources needed to transition the USIGS from 20th Century hardcopy maps and charts to the 21st Century digital information environment.

Readiness and Responsiveness. The cornerstone of the USIGS GTP is the readiness and responsiveness strategy. This strategy assures that decision makers have the geospatial information they need to be ready in peacetime, to globally navigate safely in the air and on the sea, and to accurately position other information on the earth. The strategy also ensures our ability to respond in times of crisis. To support readiness, NIMA will improve its ability to keep current its safety of navigation information while also populating a database of near-global planning information (imagery, elevation, and feature data) known as foundation data. Regardless of location or mission, the foundation data will be available to provide a trusted framework of geospatial information that will provide a worldwide level of preparedness. Foundation data will also provide the basis for responding to mission-specific requirements through the generation of more detailed geospatial information known as mission-specific data. When military operations are anticipated and expected response times are short, mission-specific data will be generated in advance. In response to other operational crises, NIMA and its mission partners will rapidly produce mission-specific data "on demand" when lead times permit. The ability of USIGS to rapidly respond with the right information at the right place and at the right time constitutes the responsiveness portion of the strategy. Key definitions are as follows:

> **global geospatial readiness.** The trusted geospatial information, services, and digital infrastructure that will be in place to support national strategic interests, operational planning, safety of navigation, and accurate positioning of other information to specific locations on the earth.
>
> **global geospatial mission responsiveness.** The capability and capacity needed to produce and deliver the right geospatial information, at the right time, to the right place.

Recommendations. The key recommendations of the plan are that NIMA, with its mission partners, must:

1. Market the USIGS Geospatial Transition Plan,
2. Implement the readiness and responsiveness strategy,
3. Develop the digital infrastructure necessary to acquire, produce, manage, maintain, disseminate, and exploit geospatial information from national to tactical levels,
4. NIMA, as the Functional Manager for geospatial information, must ensure the interoperability of digital information across organizations, missions, and systems,
5. Develop and deliver the high quality education and training programs needed to produce leaders and operators who understand how to exploit geospatial information in the context of achieving information superiority, and
6. Integrate the critical tenets of the USIGS Geospatial Transition Plan into its plans, programs, and operations.

Conclusion. Transformation is not an option. Information superiority depends on situational knowledge shared among all elements of the joint force. NIMA is the Combat Support Agency responsible for providing the imagery and geospatial foundation for the

Common Relevant Operational Picture (CROP) and must deliver the critical geospatial information and services to:

1. Visualize the mission space,
2. Bring added precision to planning, navigation, and operations,
3. Interoperate across organizations, missions, and systems,
4. Spatially reference information from other sources for situational awareness, and thus,
5. Generate actionable advice based on trusted information about the earth.

NIMA has charted a course that will better position the USIGS to transform to an environment of information superiority. The implementation is underway and affects all aspects of doctrine, training, systems, and forces. It will take a sustained effort from across USIGS to secure the commitment and resources to complete the transformation.

Introduction

In August 2000, NIMA commissioned a team to review the geospatial domain within the United States Imagery and Geospatial Information Service (USIGS). With participation from the Services and Intelligence Community, the team developed a plan to achieve a unified and integrated geospatial information service. The result of these efforts is a coordinated plan approved by the Director, NIMA that articulates the vision, strategy, processes, and organizational responsibilities needed to transform our geospatial business.

USIGS - the extensive network of doctrine, training, leadership, organizations, people, standards, procedures, hardware, and software that provides our nation with fused imagery, imagery intelligence, and geospatial information needed to achieve information superiority.

The Vision

Information superiority and the decision superiority it enables are essential to achieving the national security strategy of the United States. For the United States to remain the most powerful nation in the world our national decision makers and warfighters require an information edge to plan and conduct successful diplomatic, military, and humanitarian operations. We must embrace technology advancements, adapt our strategies, and optimize our resources to keep pace with growing demands for timely, accurate, and relevant information. We must integrate information across disciplines and organizations to provide the sophisticated analyses needed to properly address complex situations and issues. We must effectively deal with information overload by representing essential content from large volumes of data in visual displays that decision makers can quickly and easily understand.

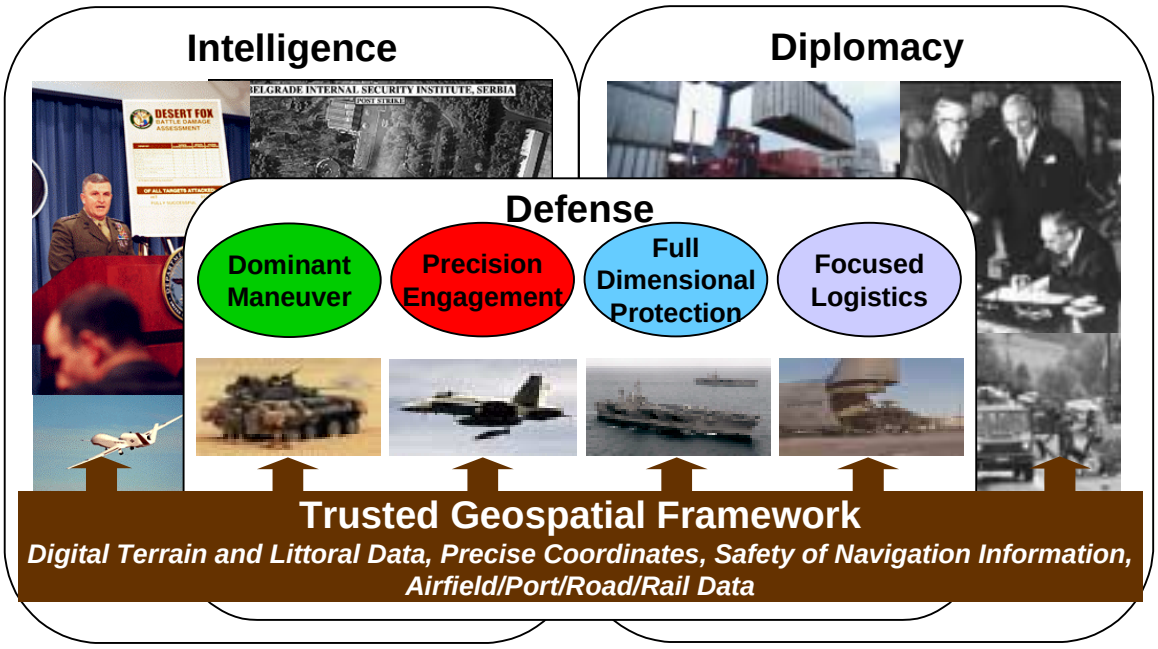


Figure 1 -- A Unifying Element for Decision Superiority

The USIGS is a significant contributor to information superiority, especially through the Common Relevant Operational Picture (CROP). Multiple information providers will register their data to a shared framework of trusted geospatial information. Most diplomatic and military issues are analyzed and considered in the context of geography, location, or cultural features. The underlying geospatial framework provides ground truth for assessing threats to national security as well as for planning and conducting a variety of operations. Visual displays merging geospatial information and real-time intelligence provide sophisticated perspectives and make possible rapid, in-depth analyses. These visual displays provide our nation's leaders with situational awareness and our military commanders with digital "battle maps" that can provide actionable advice. Both are essential elements in decision superiority. Advanced weapon systems use geospatial information for accurate inertial guidance and for the precise locations of their targets. On-board navigation systems use digital geospatial information in conjunction with the Global Positioning System (GPS) to plot courses and track location. Superior information and knowledge inside the decision cycle of our adversaries creates a decided advantage from the strategic to the tactical levels.

Geospatial information is a unifying element that transcends organizations, missions, and functions. The advantages of an integrated environment united by geography are limitless and vital for information superiority and, ultimately, decision superiority.

The Strategy

Achieving information superiority is difficult. Providing global readiness while maintaining the ability to rapidly respond in times of crisis presents a major challenge. Geospatial information requirements to support current operational contingencies far exceed our current production capacity, so we must find new business strategies to deal with an environment riddled with uncertainty. It is difficult to accurately predict where the next crisis or natural disaster will occur. Incidents often come with little or no warning, giving insufficient time to generate the required geospatial information from scratch. Conversely, it is far too costly to produce detailed geospatial information everywhere, just in case. The solution is a readiness and responsiveness strategy designed to achieve operational success.

This **readiness and responsiveness strategy** satisfies the need to remain engaged at the global level while ensuring the ability to rapidly respond at a local or regional level. At the cornerstone of this strategy is the concept of **foundation-based operations**, which is designed to make the best use of available resources.

NIMA will transition to foundation-based operations as rapidly as resources allow, with current targets of initial operational capability (IOC) in Fiscal Year (FY) 03 and full operational capability (FOC) in Fiscal Year (FY) 05. The first step in foundation-based operations is focused on **readiness**, and creates a near-global framework of trusted geospatial content at the accuracy and resolution typically needed for strategic assessment, operational planning, and safety of navigation. This information is called **foundation data** and includes elevation data, cultural and physical features, controlled imagery, precise positioning data, and safety of navigation information. Regardless of location or mission, the foundation data will be available and maintained to provide a consistent, worldwide level of preparedness or readiness. From the foundation data, one can:

- Safely navigate the air and seas,
- Generate two-dimensional views of the data in the form of screen displays or hardcopy maps and charts,
- Generate three- and four-dimensional visual representations of the earth's surface for situational awareness,
- Conduct initial terrain analyses, and
- Produce precise locations for targeting.

The second step in foundation-based operations is to enhance the foundation data to produce **mission-specific data sets** to satisfy specific mission information needs**.** Mission-specific data sets are more detailed than foundation data and contain more time-sensitive geospatial content to meet intended uses as defined by the customer. As part of the **readiness** strategy, mission-specific data sets can be generated in advance where military operations are imminent and anticipated lead times are short.

Mission-specific data sets are a critical part of responding to crises, being produced "on demand" in response to escalating tensions, emerging conflicts, or natural disasters. Mission-specific data sets are rapidly built by enhancing the foundation data that is globally available through the readiness strategy. This quick response to time-critical needs constitutes the **responsiveness** part of the strategy.

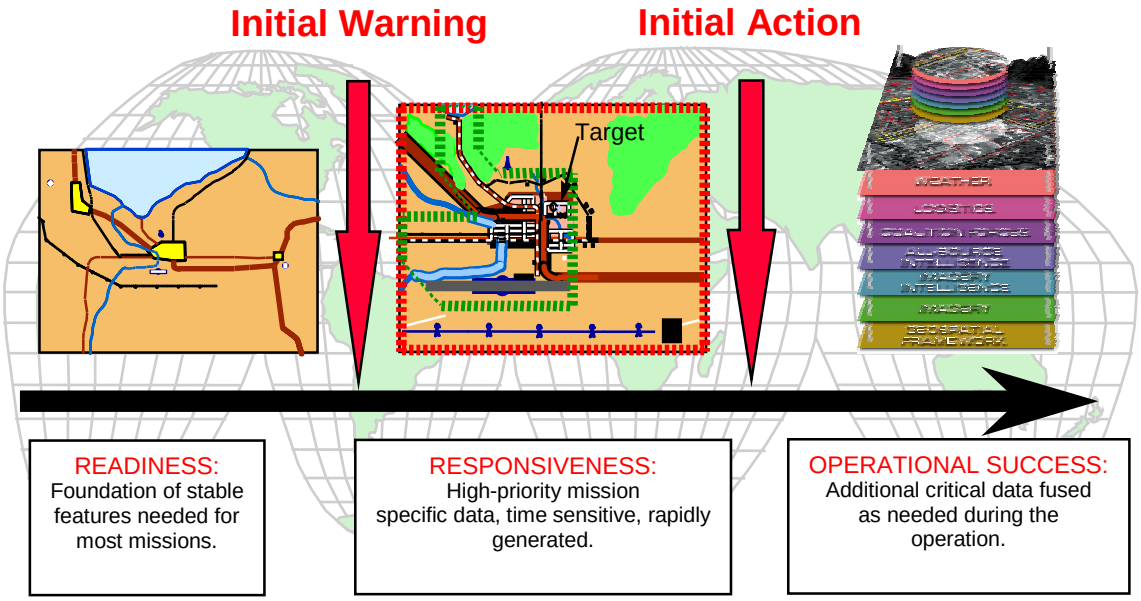


Figure 2 – Readiness and Responsiveness Supporting Operational Success

Availability of foundation data over an area of interest and NIMA's capability and capacity to respond with mission-specific data will become the new measures of geospatial readiness.

The Objectives

Foundation-based operations and the associated readiness and responsiveness strategy will require transformation of virtually every function within the geospatial domain. Moving to an information environment requires a new set of rules as well as new skills and infrastructure. Change of this magnitude requires a commitment to the following carefully planned objectives to bring all the pieces together in a coherent, consistent manner:

- Provide intelligent access to geospatial information across the USIGS,
- Develop analytic expertise to exploit geospatial information,
- Accelerate population of the seamless integrated framework of trusted geospatial information,
- Exploit new sources to include acquiring source data as a commodity, and
- Develop and implement an integrated, interoperable digital information infrastructure.

How USIGS can reach these objectives is described below.

Provide intelligent access to geospatial information across the USIGS

Vast warehouses of digital geospatial information exist across the USIGS, but accessing and using the data is difficult. We need intelligent and intuitive access to these holdings to help analysts rapidly access, discover, retrieve, and synthesize all available relevant information on a specific issue or mission. Advanced technologies provide this capability. Smart portals are simplifying information access, discovery, and retrieval while using intuitive and powerful web tools. These tools are now being applied to the geospatial information and services domain.

Develop analytic expertise to exploit geospatial information

As we migrate to an integrated digital information environment, we will require training and education in the new concepts, principles, processes, and information within foundation-based operations. Courses in geospatial concepts and principles for decision makers will be critical in ensuring the effective use of geospatial information and the actionable advice that it can provide across USIGS. Courses in creating, maintaining, acquiring, evaluating, and exploiting the geospatial information in tomorrow's integrated, web-based environment will equip technical experts for the future. NIMA's deployable personnel will also assist customers in the transition. They will help customers apply geospatial content and will provide reach-back to NIMA for additional assistance if necessary.

Accelerate population of the seamless integrated framework of trusted geospatial information

Among the objectives, perhaps the biggest and most critical challenge is populating foundation data more quickly. Building a near-global database is an enormous undertaking because of the sheer volume of information. One way we can achieve this more quickly and at less cost is by expanding our use of thematic data, such as elevation data, to populate large geographic regions. Extending our use of thematic data beyond elevation to physical and cultural features like road networks and drainage will enable us to capitalize on suppliers who specialize in building thematic data for particular market

segments. These suppliers are rapidly expanding throughout foreign and domestic industry, government, and academia.

Another way to accelerate the population of the database is by providing new incentives for contractors. New opportunities allow NIMA to contract for information creation while allowing contractors to retain commercial rights to the data. Future profit potential gives contractors the incentive to offer the original service at lower cost to the government. This type of arrangement also provides more control over the process since NIMA initiates the contract where information is needed most.

NIMA will build only what it cannot buy. As alternative sources of geospatial information are discovered, NIMA will determine their suitability to meet USIGS standards and satisfy customer requirements. NIMA will decide to buy the information based on its potential to increase overall utility of geospatial holdings. The underlying objective is to populate the geospatial database as quickly as possible with high-quality information. Under the assumption that some data is better than no data, NIMA may buy information that only partially meets USIGS standards if it provides a significant benefit to the customer. In some areas, “best available” information may be the only information available. Clear caveats and coordinated distribution will ensure that the customer understands the limitations of such information.

Customers will also contribute to population of the trusted geospatial framework by providing value-added content. This value-added content, once validated, will be integrated into NIMA's master holdings. Through the combined efforts of the USIGS and its customers, database population will be accelerated.

Exploit new sources to include acquiring source data as a commodity

The pending expansion in commercial sensors and sources of geospatial information provides an unprecedented opportunity to address existing shortfalls in coverage, currency, and accuracy. Although in their infancy, multispectral and hyperspectral imagery, in conjunction with advanced technologies, offer promise for automated feature extraction and automated change detection. Radar imagery is demonstrating its ability to provide day or night coverage and overcome perpetual cloud cover problems. Automated technologies for developing three-dimensional site models are also offering potential solutions to the rapidly expanding requirements for military operations in urbanized terrain.

Commercial companies are increasingly demonstrating their ability to be geospatial information providers and desire to expand their market share. Data collection methods run the gamut from commercial sensors to GPS devices mounted on fleets of trucks. The result is a continuous and significant increase in the amount of high-quality data available free on the web and for purchase as a commodity. Commercial providers often offer data maintenance services, freeing the buyer from the onerous and often neglected task of keeping the data up to date. Commercial sensors and data sources provide yet another possible solution for accelerating population of the trusted geospatial framework. The NIMA College will integrate these new sources into their training programs.

Develop and implement an integrated, interoperable digital information infrastructure

Fundamental to the success of foundation-based operations is the development and implementation of an integrated, interoperable digital information infrastructure. Major infrastructure improvements will include:

- On-line integrated requirements and production management system,
- Interoperable data models, standards, and architectures,
- Migration to ultimately object-based intelligence and geospatial databases,
- Gateway enhancements and portal technology for web-based access to the trusted geospatial framework,
- Workstations, tools, and interfaces to create and exploit the geospatial information, and
- Integration of intelligence and geospatial libraries.

Together these infrastructure investments will greatly enhance interoperability within the federal government, industry, and international partners. They will facilitate the integration and exchange of information critical to the CROP.

Implementation

Implementation of this plan will require significant investments in infrastructure, information, and personnel. To the extent possible, NIMA is funding the plan through its Program Objective Memorandum (POM) and Intelligence Program Objective Memorandum (IPOM). The USIGS Geospatial Implementation Master Plan provides detailed descriptions of the funded initiatives and remaining shortfalls. Success of this plan also requires commitment across NIMA and the community. NIMA is committed to training our workforce, evolving to foundation-based operations as rapidly as possible, and building the required integrated imagery, imagery intelligence, and geospatial information infrastructure.

The vision, strategy, and objectives in this plan will provide us with the geospatial information edge needed across the full spectrum of missions. It will provide the ground truth critical to executing the tenets of Joint Vision 2010 and 2020 and supports the collaborative intelligence community of the future. Details of the plan can be found in the three distinct, complementary sections of this document and associated appendices:

- USIGS Geospatial Concept of Operations for 2010,
- USIGS Geospatial Implementation Master Plan, and
- Recommendations.

United States Imagery and Geospatial Information Service (USIGS)

Geospatial Concept of Operations for 2010

(Short title: USIGS Geospatial CONOPS 2010)

AUGUST 2001

I. USIGS Geospatial Concept of Operations for 2010

1. Preface

The USIGS Geospatial CONOPS 2010 envisions and articulates a shared view of the critical role geospatial information plays in our national security. This document is an input document for refining the USIGS Operational Architecture and is an integral part of the USIGS 2010 CONOPS and the USIGS 2010 Information Systems CONOPS. The document provides a broad outline of USIGS geospatial operations in 2010 and a vision for the desired end-state of foundation-based operations. It is also a common, guiding document for integrating geospatial aspects of the operational application of geospatial information across USIGS; information access, discovery, and retrieval; requirements management; information acquisition, production, and management; and doctrine, training, and people.

1.1 The Need

Geospatial awareness, an understanding of the earth's surface, is basic to sustainable environmental development, global economic engagement, diplomacy, and military action. The successful, spatially aware decision maker has an understanding of decision space and situational awareness, which are essential elements in achieving information superiority[1] and, ultimately, decision superiority.

The Intelligence Community (IC)[2] monitors situations worldwide to provide advance warning for the National Command Authority, military commanders, and others. Continued international engagement by the United States in our volatile world demands smooth, timely intelligence support, underpinned by geospatial[3] understanding, that can flow seamlessly into force deployment and military operations.

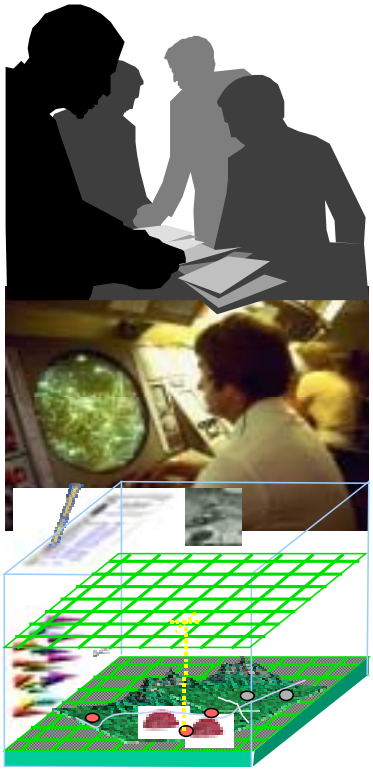


Figure 3 – Support for Decisions

Decision makers ideally make decisions inside the decision cycle of opponents by relying on actionable advice from trusted subordinates. These subordinates base their recommendations on judgments and predictions by technical experts who must have a coherent view of trusted, relevant information.

[1] Information Superiority is the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same

[2] The Intelligence Community includes Director Central Intelligence (DCI), Central Intelligence Agency (CIA), National Security Agency (NSA), Defense Intelligence Agency (DIA), National Reconnaissance Office (NRO), National Imagery and Mapping Agency (NIMA), intelligence elements of the Army, Navy, Air Force, and Marine Corps, other offices of the DoD for collection of intelligence through specialized reconnaissance programs, intelligence elements of the Federal Bureau of Investigation (FBI), Department of Treasury, and Department Of Energy, and the Bureau of Intelligence and Research of the Department of State

[3] Geospatial information is any information about the earth that has associated with it some contextual, spatial, and temporal reference; more specifically, it is a collection of precise, spatially co-referenced information about the earth, with temporal tags arranged in a coherent structure and format

Military decision makers make the quickest decisions when primary staff already have the fused predictions on which to base actionable advice; this is the Common Relevant Operational Picture (CROP) at its best. The deeper the reach-back, touching more organizations and invoking more processes, the longer the decision cycle and the greater the operational risk.

National decision makers, military planners and operators, and intelligence analysts need assured access, without advance notice or requirements, to geospatial content that can support area familiarization, planning, safety of air and sea navigation, and limited emergency operations such as search and rescue or response to natural disasters. With appropriate priorities and reasonable advance notice, they should have confidence that the more dense and time-sensitive geospatial content needed to conduct planned operations will be ready before orders are given. Finally, they should have confidence that such content can be prepared quickly enough, even when not anticipated in plans, to effectively support crisis operations anywhere in the world.

1.2 The End-state: Foundation-based Operations

In the past, customers could plan and execute missions with paper maps and charts, registering the situation, control measures, and other essential information by annotating the maps and charts directly or by marking up transparencies for use as overlays. With advances in geospatial technology, networking, and virtual displays, customers expect rapid fielding of integrated packages of information to support their decision making. They also expect the data to be available when needed to support their missions. They expect geospatial support to be part of the information technology revolution.

In 1997, the Geospatial Information Infrastructure (GII) Master Plan outlined an approach to a GII Framework consisting of foundation data (FD), mission-specific data sets (MSDS), qualified data, and local information that could support missions through framework services and user views. The entire framework depended on a comprehensive data architecture to enhance interoperability throughout the support structure and among customers. This approach is still solid, and has matured into a concept now called foundation-based operations. USIGS is shifting its focus from products, most of which had to be made "just in case" because of long production lead times, to the underlying geospatial content, from which needed views can be made "just in time." NIMA has committed to making foundation-based operations its basic business model and, by extension, foundation-based operations are becoming the business model for USIGS. The support strategy in foundation-based operations is one of global readiness for planning and ongoing operations coupled with capability and capacity to respond in crisis.

The core of the readiness and responsiveness strategy is **foundation data** (FD). FD is the trusted near-global framework of geospatial information capable of supporting national strategic issues, global safety of navigation, operational planning, and the precise positioning of other information on the earth's surface. It consists of digital imagery; elevation, safety of navigation, and feature content; and geodesy and geophysics data that producers and customers can integrate for three dimensional views, manipulate for exploitation, generalize for overview purposes, analyze for impact of the environment on operations, symbolize as appropriate, and view on computer screens or in hardcopy.

The National Imagery and Mapping Agency (NIMA), certified contractors, and some customers themselves will densify FD into **mission-specific data sets (MSDS)**. MSDS

has more detail than FD, and contains more time-sensitive geospatial content needed to meet specific mission requirements and conduct the full range of operations. As mission-specific data is generated, it can be made available and pushed or pulled forward without waiting for an entire "product" to be completed, finished, printed, and shipped. MSDS may also include the “tailoring” or analysis of available geospatial information to support both the information needs of a decision maker and subsequent mission execution.

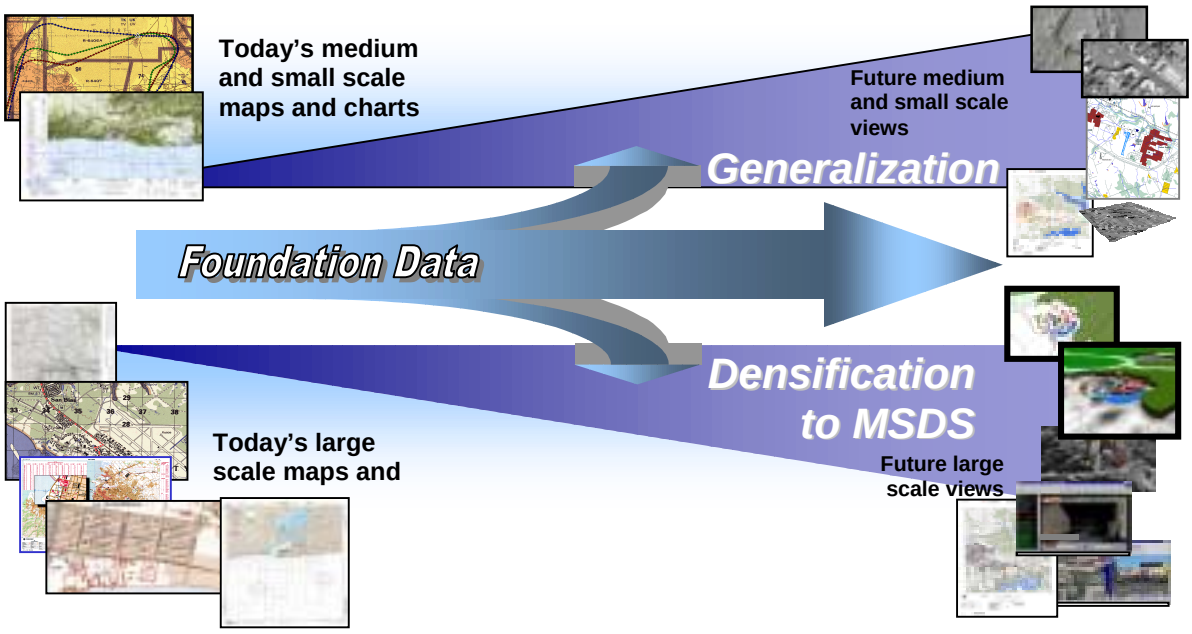


Figure 4 – The Transition from Products to Visualization

Both FD and MSDS, as illustrated in Figure 4, serve as digital sources for visualization displays, analysis, and hardcopy printing. FD and MSDS provide the geospatial content of the CROP. This concept is referred to throughout this transition plan as foundation-based operations. Through foundation-based operations, geospatial support will meet future challenges to our national security.

1.3 The Environment of Engagement in 2010

The following description of the environment in 2010 for the United States and its geospatial operations is based on trends identified in recent reports from the National Intelligence Council (NIC)[4] and the NIMA Commission.[5]

1.3.1 Global Situation

In 2010 nearly half of the world’s population will be urban. Internal national conflicts will pose the most frequent threat to stability. Many internal conflicts, particularly those arising

[4] NIC 2000-02, Global Trends 2015: A Dialogue About the Future With Nongovernment Experts, December 2000; http://www.cia.gov/cia/publications/globaltrends2015/index.html

[5] Report of the Independent Commission on the National Imagery and Mapping Agency, The Information Edge: Imagery Intelligence and Geospatial Information in an Evolving National Security Environment, December 2000; http://www.nimacommission.com

from communal disputes and confrontation over limited environmental resources, will continue to be vicious, long lasting, and difficult to terminate.

1.3.2 Role of the United States

The US will continue to engage economically, diplomatically, or militarily in pursuit of national interests

The United States will be economically powerful, diplomatically active, and militarily strong. With our decisive edge in both information and weapons technology we will remain the world's dominant military power. We will engage economically, diplomatically, or militarily in pursuit of our national interests. The wide range of interests, opportunities, and challenges facing the nation in 2010 will require diplomacy that can effectively advance US interests while making war a less-likely last resort, a military that can both win wars and contribute to peace, and an intelligence apparatus that can support both.

1.3.3 International Relations

The US may have bilateral or multilateral support, but needs to be prepared to go it alone if necessary

The United Nations (UN) and several regional organizations will continue to manage some internal conflicts because major states – stressed by domestic concerns, perceived risk of failure, lack of political will, or limited resources – will wish to minimize their direct involvement. World leaders will respond sporadically to foreign crises – either through the UN or in ad hoc "coalitions of the willing" – but they will not make strong and consistent overseas commitments, particularly with regard to sending troops.

1.3.4 Governmental Trends

Domestic policy agencies and private groups will become increasingly important partners in national security actions

To deal with a transnational agenda and an interconnected world, governments will have to develop greater communication and collaboration between national security and domestic policy agencies. Increasingly, governments will work collaboratively with non-governmental organizations (NGOs), private volunteer organizations (PVOs), and non-profit organizations.

1.3.5 The Private Sector

Nations will gain advantages if they have access to information in combination with the technology needed to exploit it. Open sources for data and advanced geospatial information technologies are rapidly becoming available commercially. Those nations able to optimize this combination of resources can achieve significant advancements not only in spatial awareness but also in precision location. International commercialization of space may give our adversaries access that would make them rivals of today's major space powers in such areas as high-resolution reconnaissance, weather prediction, global communications, satellite-based navigation, and precise targeting.

1.3.6 Technology

Technology will advance and reach the market rapidly, giving the US some temporary technological advantages

Local-to-global Internet access holds the prospect of ubiquitous wireless connectivity via hand-held devices and large numbers of low-cost, low-altitude satellites. Strong communications foster a general impatience with waiting within our culture and also lead to rapid transitions from concept to market. The time between discovery and application of scientific advances will continue to shorten. Civilian technology development already is driving military technology development in many countries. As a result, defense-related technologies – particularly precision weapons, information systems, and communications – will advance rapidly. The United States will maintain a strong technological edge in information technology-driven "battlefield awareness" and in precision-guided weaponry. Higher resolution satellite imagery from commercial sources will fuel the next generation of USIGS-relevant commercial-off-the-shelf (COTS) technology. In an environment of broad technological diffusion with emerging technology available to virtually anyone with the money to pay for it, nonmaterial elements of military power – strategy, doctrine, and training – will increase in importance in deciding combat outcomes.

1.3.7 Conflicts

Real challenges to the US military will be asymmetric, avoiding strengths and going after perceived weaknesses

Opponents of the US will not want to engage our military on our terms. They will more likely choose political and military strategies designed to dissuade the United States from using force. If the United States does use force, our opponents will attempt to exhaust American will, circumvent or minimize US strengths, and exploit perceived US weaknesses. In the event of war, urban fighting will be typical. Consequently, civilian casualties will be high relative to those among combatants. Adversaries also are likely to use cyber attacks to complicate US power projection in an era of decreasing permanent US military presence abroad. They will seek to disrupt military networks during deployment operations, when they are most stressed.

1.4 Assumptions

This CONOPS is based on the following assumptions for 2010:

1.4.1 Roles and Responsibilities

Basic roles and responsibilities will be stable, but how and where hardcopy products are made will begin to shift

Organizational components that constitute the USIGS retain their core missions and customer support responsibilities for which they were established. By aggressively pursuing leading-edge technology and continually refining its business practices, NIMA will remain the information service provider of choice for a trusted, accurate, and current framework of geospatial information. This framework will be capable of dealing with global national security issues, regional threats, and the increasing probability that US forces will engage in urban operations. NIMA will also maintain its legacy mission responsibilities for large-quantity printing of hardcopy standard views of geospatial information, although the trend

will be toward distributed production of tailored and fused hardcopy products by the USIGS, presumably in lower volumes, under shorter lead times, and closer to the site of need. NIMA will operate the NIMA College (NIMC) to support the training requirements associated with transition to foundation-based operations.

1.4.2 Added Dimensions

Production and presentation of geospatial information will advance beyond the classic two-dimensional and simple three-dimensional (3D) views of the operating space available today to robust three-dimensional views extended over time (the fourth dimension) to support future time-critical analysis and visualization requirements of decision makers.

1.4.3 Limited Resources

USIGS will always need to allocate limited resources judiciously; it will continue to need a process for identifying and managing the geospatial information requirements and priorities of the Intelligence Community and our defense forces.

1.4.4 Commercialization of Standards

In an era of maturing commercial capabilities in remote sensing and the extraction of geospatial content, NIMA will shift from military standards to open international and commercial models, standards, and specifications. The Open-GIS™ Consortium, in collaboration with the International Organization for Standardization, is working with international and commercial organizations to accelerate the development and implementation of open standards. This will advance interoperability and consistency across coalition partners, the Intelligence Community, the Services, supporting systems, and a broader range of missions. This transition from strictly military standards to open exchange standards will need to be closely coordinated with the USIGS customer base while NIMA maintains the ability to support legacy specifications and standards.

1.4.5 Availability of Commodity Data

Increasing availability of imagery and geospatial information as commodities on the market will allow the USIGS to adopt new business models. The USIGS will become a "smart buyer and broker" of these commodities by assessing their quality, bringing their content together, and exploiting the resulting integrated data. Maintaining the content of this integrated data (e.g., keeping the road net up to date) will become a major task. NIMA and its USIGS partners will emphasize commodity data purchases that include maintenance strategies.

1.4.6 Security Constraints

We will continue to deal with replicated content in differing security levels, resulting in varying access and release restrictions for what is essentially the same information.

1.4.7 Web Enablement

World Wide Web-based technologies will continue to develop rapidly. They will provide rich opportunities for many organizations to plan, share information, acquire, generate, train, value-add, and execute across a widely-distributed heterogeneous network. To

facilitate this collaboration, the USIGS will become a smart buyer of web-based technologies and adopt commercial best practices for acquiring the data. USIGS will protect the information and access by implementing web security measures such as encryption.

1.4.8 Tools

Geographic information system (GIS) tools will be commonplace, causing greater demand for complex, seamless, and accurate geospatial information that is interoperable regardless of its native format. The USIGS will develop enhanced processes for evaluating and training on geospatial tools to ensure their proper utilization, quality of their results, and consistency of their performance.

1.4.9 Hardcopy

For the foreseeable future, there will continue to be a demand for paper maps and charts, especially in austere environments at forward-deployed locations without access to the supporting digital infrastructure.

1.4.10 Bandwidth Limitations

Available communications bandwidth at the national, theater, and tactical levels will continue to lag behind imagery, imagery intelligence, and geospatial information capacity and performance needs. In addition, competition for the limited bandwidth available will continue to be intense. Geospatial customers and producers will therefore continue to be judicious in requiring only that data or information necessary to perform the mission. USIGS will continue to support customer strategies that emphasize pre-positioning of relatively stable information. See Appendix D, Responsiveness Strategy and Bandwidth, for the communications estimate.

1.4.11 Diverse Customer Base

The customer base will have diverse geospatial knowledge, expertise, technologies, and system capabilities. Plans and programs between NIMA and the remainder of the USIGS must therefore address issues of training and education, information management, information access and dissemination, exploitation tools, and refined requirements processes. Exercises, experiments, and demonstrations provide opportunities to work out these issues at minimal risk to operational forces.

1.4.12 Common Data Models

A data model, with data definitions, assures common understanding between sender and receiver

The USIGS Enterprise Data Model (UEDM), a significant and important element of geospatial interoperability, is accepted as the DoD model for geospatial information, imagery, and imagery intelligence. Implementation of the UEDM[6] in logical and physical database schemas will ensure interoperability across the USIGS. Section 2.1.3 (Data Models) discusses the UEDM in more detail.

[6] The USIGS Enterprise Data Model provides a precisely defined, functionally neutral, normalized definition of the data and their relationships needed to satisfy the combined information requirements for USIGS.

1.5 The Decision Superiority Environment in 2010

1.5.1 Strategy and Operational Concepts

The Director, Central Intelligence (DCI) Statement of Strategic Intent highlights our future national security challenges and outlines a strategy of responsiveness based on unified operations, investing in key technologies, and ensuring that we maintain a world-class workforce.

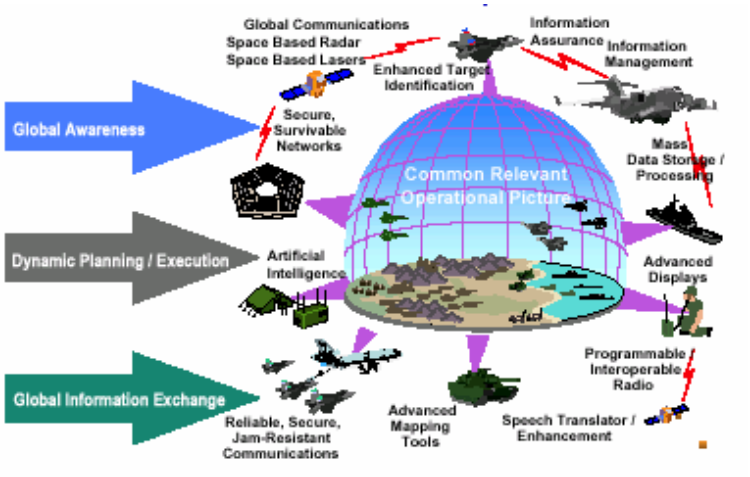
The desired geospatial end-state for 2010 must align with the DCI Statement of Strategic Intent

Joint Vision 2020 (JV 2020) builds upon the tenets established in Joint Vision 2010 (JV 2010). “Full-spectrum dominance" is a key term in JV 2020. Given that the mission of the US military is to fight and win our nation's wars, full-spectrum dominance means that US forces have the ability, whether operating alone or with our allies, to defeat any adversary and control any situation across the growing range of military operations. While full-spectrum dominance is the goal, the way to get there is to invest in and develop new military capabilities. JV 2020 also recognizes the importance of having trained people who understand and can exploit these new technologies. Our advantage must come from doctrine, training, leaders, organizations, and people who enable us to take advantage of technology to achieve superior warfighting effectiveness. A trusted digital geospatial information framework will be a strategic driver to set the stage for achieving the future warfighting vision.

The desired geospatial end-state for 2010 must also align with JV 2010 and set the stage for JV 2020

1.5.2 The Role of Information Superiority

Key to US dominance in any conflict is decision superiority, translating information superiority into better decisions that are formulated and implemented faster than an enemy can react. Development of a global information infrastructure will provide the ability to visualize and analyze the mission space as well as provide the geodetic control needed for fusion of other spatially referenced information. At the heart of this global information infrastructure will be the CROP. Contributors will build this picture by fusing their information to a spatially controlled view of the operating space that is defined and underlain by a trusted framework of geospatial information. Customers will be able to discover, access, and retrieve trusted information relevant to their specific missions with assurance that the underlying data is available and interoperable across the USIGS.



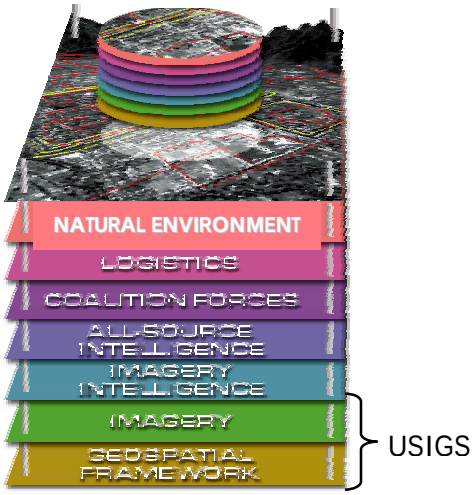


Figure 5 – The Framework Enabling Information Superiority

Information superiority is also critical to the success of precision-guided weapons, which the United States has used to dramatic effect in the recent past. The geospatial component of this weaponry is no less critical. The continued increase in use of precision weapons will require an equal investment in accurate geospatial information used for targeting. We must improve not only our ability to target but also our ability to identify “no strike” zones.

We will give our warfighters superior situational awareness and enable precise targeting. Rendering our operational areas in three and four dimensions supports a simulation ability that is indispensable for preparing warfighters for difficult missions. Accurate digital elevation modeling permits closer nap-of-the-earth (NOE) flying, an increased ability to use terrain to mask or unmask operations, and better selection of weapons. Modeling, simulation, planning, training, and mission rehearsal are blending into a continuum with command and control of

Geospatial information underpins the CROP and enables winning decisions

operations. USIGS must respond with a common geospatial framework of information, based on a common data model, upon which all forces must operate.

Without exclusive ownership of high-resolution geospatial information, we must compensate with better use

In 2010, the US will not enjoy exclusive ownership of high-resolution geospatial information. When commercial remote sensing satellites are yielding 0.5m or higher resolution imagery, and commercial firms are extracting geospatial information from this imagery and marketing it as a commodity, our opponents can obtain the same information. Our information superiority must then depend on rapid fusion of information to build a more trusted geospatial framework than our opponents will have. This fusing of information allows for more rapid updates and more rapid movement of geospatial information at the lowest possible security classifications to enable solid decisions within our opponents' decision cycles. To gain these advantages, we must focus our research and development where it gives the United States an edge over opponents and then field and protect those technologies.

1.5.3 Challenges

The NIMA Commission report of December 2000 notes that US military doctrine has evolved to so rely on intelligence (and, by extension, on geospatially-referenced information) that it may become unsupportable with current investments. The need to precisely engage any and every tactical target, without collateral damage or risk to American lives, requires perfect knowledge. Reliance on information superiority to deliver bloodless victory demands intelligence and geospatial information well beyond that which current investments can provide.[7]

The geospatial elements within USIGS have performed heroics in past national crises using constrained resources, considerable adrenaline, and some luck to get critical geospatial support in place, on time, without costly mistakes. The stakes continue to climb. Our military forces are replacing 70-ton tanks designed to absorb first hits with 20-ton combat vehicles that rely on agility and exquisite intelligence to avoid being hit. We are also replacing ballistic weapons with precision weapons for surgical strikes, flying ever closer to the ground, and planning to conduct around-the-clock operations under all weather conditions. Figure 6 illustrates some of the many challenges envisioned to future information superiority.

We must invest early in the trusted framework of digital geospatial information to understand how other "multi-INT" providers will graphically and spatially reference their information. System developers also must learn how to employ this new digital base of information to our strategic advantage.

[7] Paraphrased from Report of the Independent Commission on the National Imagery and Mapping Agency, December 2000, pp. ix, 28

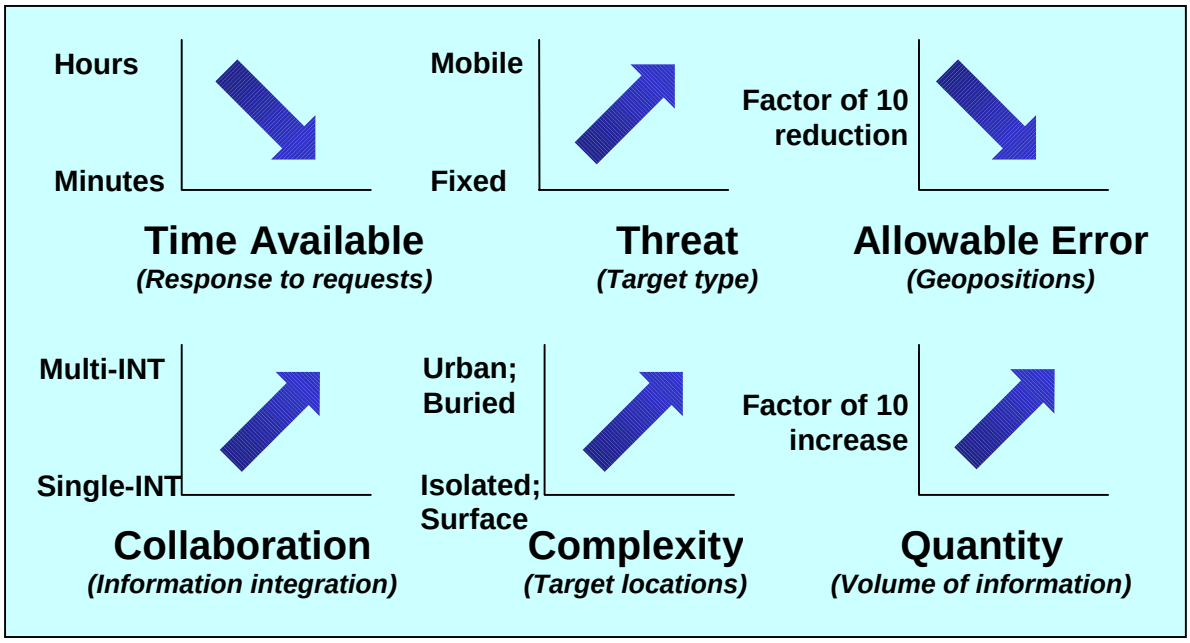


Figure 6 – Challenges to Information Superiority

Our future geospatial information infrastructure must fully support the United States' national security apparatus and our absolute requirements for information superiority.

1.5.4 The Vision for Geospatial Support in 2010

USIGS will be firmly established in foundation-based operations in 2010. Customers will be comfortable with digital views and graphics of the mission space needed for situation awareness, planning, and execution.

In this future geospatial environment:

- at any time, for any place on earth, the CROP will have sufficient maintained foundation data (a trusted near-global framework) and other geospatial data of known quality to permit planning, battlespace familiarization, and limited operations
- leaders will have access to command and control systems that convey views of the mission space based on a shared geospatial framework
- NIMA will remain both the provider of choice and data broker for geospatial information, serving as a one-stop source for trusted content that may come from many sources, including the commercial sector
- soldiers, Marines, sailors, and airmen will have gained an understanding of battlespace, the situation, and their leaders' intent through battle graphics created by command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems
- USIGS will have dedicated, educated, and trained government assets and a robust industrial base for mission-specific data set (MSDS) surge production

- intelligence analysts will benefit from and contribute to a trusted geospatial framework as a matter of course in their work
- combat platforms and warfighters will navigate primarily with the Global Positioning System (GPS) and Inertial Navigation System (INS) backup, and obtain immediate knowledge of their surroundings from a navigation-slaved display of geospatial content that rivals or exceeds the precision of their navigation systems
- the NIMA portal will provide access to the geospatial information holdings of the USIGS using international and commercial exchange standards
- customers will have access to a commercialized Joint Mapping Toolkit (JMTK) in the Global Command and Control System (GCCS) and its related Service environments to manipulate geospatial content in the CROP; the JMTK or its successor will be intuitive, reliable, have verifiable results, and will provide core functions desired by those who are not geospatial experts
- geospatial technical experts will be accessible to assist in analyses and visualizations that are beyond JMTK capabilities; they use trusted, certified tools that are shared across the USIGS
- customers will request mission-specific data, based on intended use and the corresponding database content, using international and commercial standard exchange formats
- data for modeling and simulation used for mission planning and rehearsal will be the same as that for command and control
- lessons learned from successive exercises and missions will provide the bases for additional data requirements that will cause NIMA to expand its capabilities to provide information
- change detection will trigger data maintenance, which will be increasingly autonomous; customers will receive or can request updates as dataset, feature, attribute level, and metadata changes occur
- dynamic links to distributed databases and collaborative input from multiple producing agencies will enable one-touch maintenance of a master, minimally-redundant, digital representation of the earth; participating agencies include those responsible for the major domains of intelligence, or “INTs”, making geospatial content the framework for and a primary enabler of multi-intelligence (multi-INT) operations
- producers and customers will know the quality of geospatial content (currency, density, accuracy of attribution, accuracy of position, logical consistency, completeness) and will propagate quality measures through all subsequent operations
- customers at all levels will have confidence in the levels of trust they can place in visualizations and analyses based on the accuracy, quality, and lineage of geospatial content used
- value-added feedback from users will flow into the one-touch maintenance environment as nominations for change.

2 Geospatial Support Needs in 2010

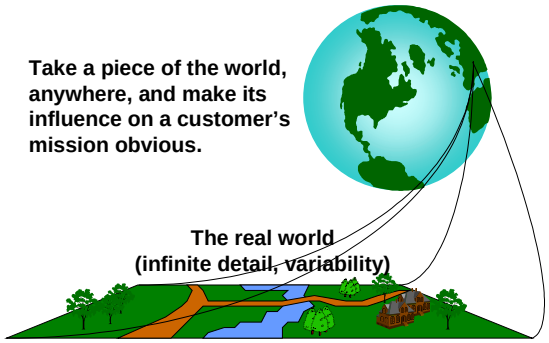


Figure 7 – The Basic Mission

Whether the mission be economic, diplomatic, military, or humanitarian, US national interests in 2010 could take decision makers anywhere in the world. The geospatial support mission is to take that area of the real world and reduce ambiguity in the decision process by providing accurate, current, and relevant geospatial information.

Decision makers control their assets against whatever opposition they face. They do this within the context of the three-dimensional environment over time. They can achieve critical advantage by emphasizing geospatial information in visualization, analysis, targeting, and information fusion. Geospatial information is the backdrop to the digital "battle map," represented in Figure 8.

No one can perfectly know the environment, threat forces, or even friendly forces. Therefore, some measure of uncertainty affects all intelligence and decision making. We should, however, by 2010 be able to quantify, manage, and effectively present the uncertainty contributed by geospatial content.

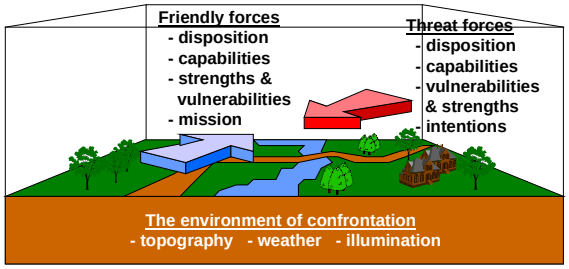


Figure 8 – The Framework for Decision Making

The geospatial component of the environment is known through observation, measurement, study, and analysis. A hierarchy of data, information, knowledge, and wisdom (Figure 9) contributes to an understanding of how geospatial content is processed to yield actionable advice and predictions.

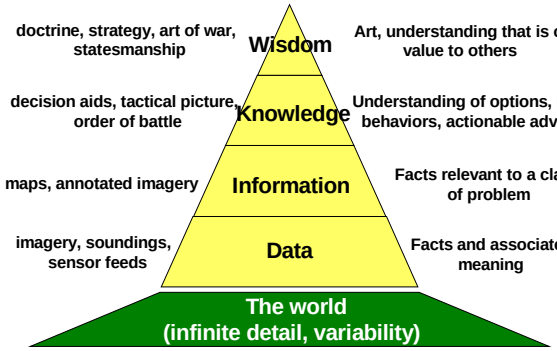


Figure 9 – Processing Geospatial Content for Decision Making

In this hierarchy, automated processes or geospatial analysts study huge amounts of raw source data (hundreds of megabytes of imagery per square kilometer, for instance) to condense them through extraction into elevation surfaces and natural and manmade features (taking up some tens of megabytes per square kilometer to encode). Other analysts may then filter the resulting geospatial information for relevance to an operation and perhaps reduce it in volume to some tiny contribution to a probability of success for a potential course of action. As processes in the hierachy filter out data volumes and level of detail, they enhance relevance to a situation and value to the decisionmaker.

Enablement of superior decisions is the ultimate measure of merit of geospatial support. This section develops the picture of geospatial support in 2010 from a customer viewpoint. It provides the flow of geospatial information support via progressively deeper reach-back through the pyramid of knowledge, information, and data.

2.1 A Basis for Understanding this Document

NIMA will implement a readiness and responsiveness strategy as a key enabler of information superiority

This USIGS Geospatial CONOPS 2010 offers the reader a view of USIGS geospatial operations "from the outside in," meaning that the view is created from the customer's perspective. It articulates NIMA's readiness and responsiveness strategy for providing geospatial information, products, and services. Foundation data addresses the USIGS requirement for global readiness. Global readiness depends on the trusted geospatial information, services, and digital infrastructure that will be in place to support national strategic interests, operational planning, safety of navigation, and the precise positioning of other information to specific locations on the earth. Geospatial responsiveness is the capability and capacity needed to produce and deliver the right geospatial information, at the right time, to the right place. Section 2.2 treats the geospatial lines of demarcation and the role of NIMA as the USIGS Functional Manager for geospatial operations. Section 2.3 presents the customer's perspective of geospatial support. Section 2.4 treats the geospatial provider perspective, essentially a view of the USIGS Geospatial CONOPS 2010 from within NIMA. Understanding the concepts of foundation data, mission-specific data sets, and common data models will simplify understanding of subsequent sections.

2.1.1 Foundation Data

By 2010 foundation data (FD) will be an assemblage of geospatial data that is collected nearly worldwide. It is independent of missions, relatively stable, accurate, and tied to a common 3-D geometry of the World Geodetic System 1984 (WGS 84) ellipsoid. FD consists of controlled and orthorectified multi-sensor imagery, elevation data, bathymetry, vector features including air and nautical navigation safety, and other data such as gravity and magnetics.

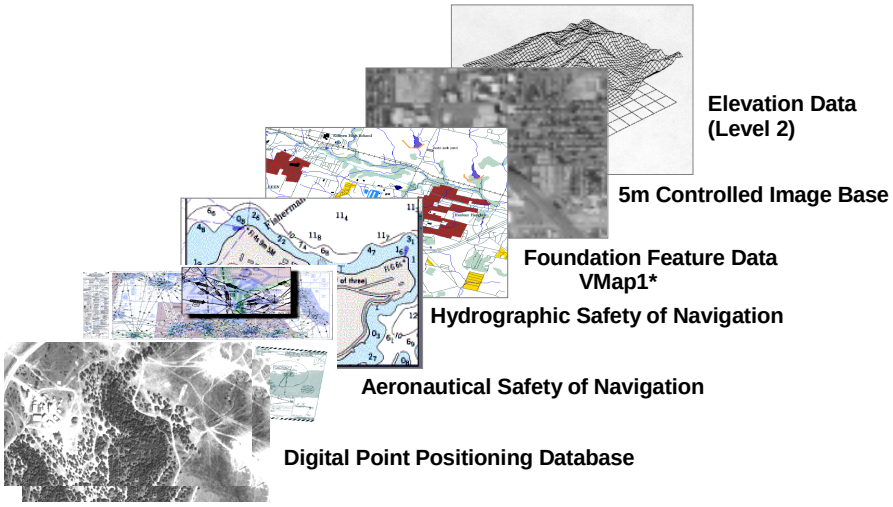


Figure 10 – Foundation Data Components

* As Foundation Feature Data becomes available, VMap1 will be eliminated

FD is the trusted near-global framework of geospatial content used to address global national security issues, plan operations, safely navigate in the air and on the sea, and accurately position other spatially referenced information. It consists of digital content that can be manipulated and used, with appropriate geographic information system (GIS) tools, to visualize, analyze, and fuse information as needed to enhance the viewers' understanding of mission space. These views can be generated using a wide range of digital display devices or in hardcopy as required.

FD is fundamental to understanding this document and the plan to support the global readiness requirements of our national and military strategies. This foundation of geospatial information also provides the basis for rapidly responding to mission-specific requirements.

2.1.2 Mission-Specific Data Sets (MSDS)

FD provides the near-global content for all geospatial users to select any area of the world applicable to their area of interest and build a mission plan. The user may require more information or higher resolution in given areas for actual mission execution. MSDS satisfies the need for geospatial data of greater detail, and constitutes the responsiveness portion of the USIGS readiness and responsiveness strategy.

Mission-specific data contains the more time-sensitive and robust geospatial content needed to conduct detailed planning and the full range of operations. However, since MSDS is more temporal in nature, it rapidly becomes out of date. Therefore, the goal is for the USIGS to have both the capability and capacity to rapidly generate MSDS in response to operational requirements. Under some circumstances, MSDS may have to be generated in advance and maintained.

2.1.3 Data Models

A NIMA objective for 2010 is to possess a seamless, interoperable framework of geospatial information in many forms, including raster, vector, text, and video. To ensure interoperability across coalitions, organizations, Services, missions, disciplines, and

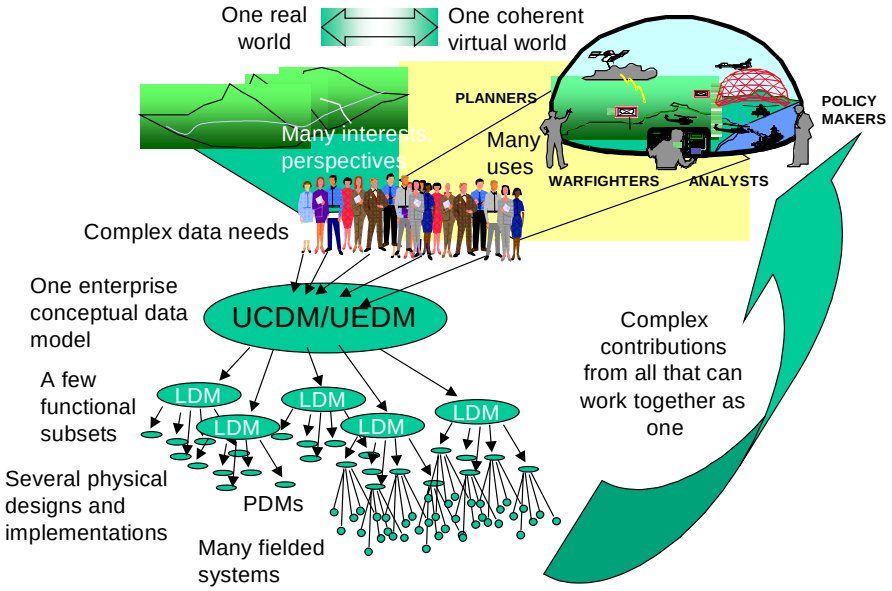


Figure 11 – UCDM/UEDM Three-Tier Model

systems, NIMA manages the data environment for USIGS. This managed data environment enables an unambiguous CROP. Figure 11 illustrates the three-tier data model environment and how it relates to the vision of a coherent picture for decision making.

Management of the geospatial data environment begins with the USIGS Conceptual Data Model (UCDM). The UCDM establishes consensus on data definitions, attributes, and relationships. For the UCDM to establish consensus, and to determine responsibility for data generation, members of the geospatial community will need to contribute their understanding and expertise.

The UCDM provides a precisely defined, functionally neutral, normalized definition of the data and their relationships

The UCDM is the basis for models that result in actual databases. To meet the needs of a single function (e.g., terrain analysis, targeting, navigation), a logical data model (LDM) is derived from the UCDM. Consequently, multiple logical data models may be derived from the UCDM and include multiple representations of a single feature. For example, an LDM for hydrographic aids to navigation and an LDM for critical landmark features may both include a lighthouse. The UCDM ensures a common definition for this lighthouse and its relationship to its surroundings. Use of the UCDM also ensures that the same attributes of a feature, such as the height of the lighthouse, use common descriptors or in some way rationalize the differences between two descriptions.

From a logical model, physical data models (PDMs) are derived that take into account the needs of specific system configurations and software applications. System developers derive physical data models to optimize system and database performance. Although logical and physical implementations of the model will differ based on mission applications, compliance with the UCDM will ensure interoperability when exchanging information. The payoff for compliance with the UCDM is interoperability of information across organizations, missions, and functions.

NIMA will also use the UCDM to establish entries in Geography Markup Language (GML) registries being developed primarily by commercial vendors through the Open-GIS™ Consortium and international standards organizations. Such registries currently allow such diverse groups as national, state, and local governments, forestry organizations, and water resource management services to openly exchange geospatial content across the web. Development of GML registries based on the UCDM will allow the national security community to enjoy unambiguous movement of defined content.

Over time, the UCDM will expand beyond the purely geospatial information domain to a USIGS Enterprise Data Model (UEDM) that fully includes imagery and imagery intelligence. This UEDM will differ significantly from the existing model in that it will expand beyond the geospatial domain and reflect advances in object-oriented database technologies.

The UCDM will expand beyond the purely geospatial domain to include the imagery and imagery intelligence missions to become the USIGS Enterprise Data Model (UEDM)

2.2 Lines of Demarcation and the Role of the USIGS Functional Manager

Clear lines of responsibility are essential to success

The military Services are responsible for manning, equipping, and sustaining the force. Military forces, when assigned to Commands, are functionally augmented by combat support agencies such as NIMA, the Functional Manager for geospatial information within USIGS.

The depth to which NIMA deploys people, fields equipment, supplies information, and operates systems will vary by Command and Service. Forces will ordinarily deploy with some "basic load" of geospatial information for their area of interest. At the same time, NIMA will generate added and updated content and make it available to the Unified Commands and intelligence centers, Joint Task Forces, Service intelligence centers, and other customers as required. Navy, as an exception, will use Department of Defense teleports for the dissemination of geospatial information. NIMA will also provide geospatial information to regional information management centers for satellite broadcast.

Topographic engineer units, terrain teams, CINC and Service intelligence centers, Air Operations Centers, and other intermediaries collect, generate, store, manage, analyze, and disseminate geospatial content for the decision makers, warfighters, and other customers they support, as shown in Figure 12. As DoD transforms, additional geospatial information visualization and analytical capabilities may be developed and implemented for combatant commands as part of the overall goal of achieving dominant battlespace awareness.

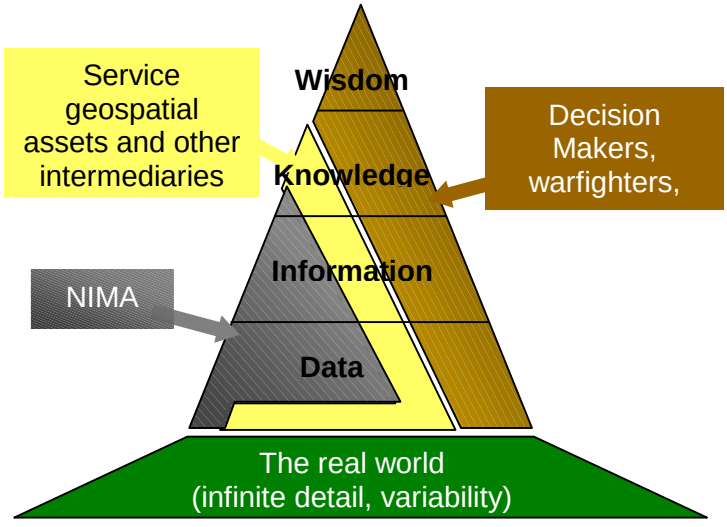


Figure 12 – Roles

Appendix B outlines the Services' future operational concepts for geospatial support. Each Service, as well as the remaining geospatial community, will need to assess the impact of this plan on its policies, doctrine, training, leadership, organizations, materiel, and people. This plan recognizes that there is a requirement for extensive USIGS education and training programs to facilitate the transition. NIMA and its mission partners will collaborate to provide the education and training programs required to address differences in organizational capabilities while striving to meet goals of the community.

As leadership continues to discuss and make decisions on the lines of demarcation, all participants must clearly understand the impact on their roles and responsibilities. They must conduct exercises, experiments, and demonstrations to clarify details, develop lessons learned, and implement course corrections over time as USIGS evolves. They

should then reflect the lines of demarcation in implementing policy, doctrine, concepts, prototypes, plans, and capabilities across the USIGS.

NIMA performs a central role in making the USIGS work smoothly. As Functional Manager, NIMA provides guidance for all participants to consider in their planning, programming, and budgeting.

2.2.1 Functional Manager Responsibilities

NIMA is the Functional Manager for imagery, imagery intelligence, and geospatial information for the USIGS.

NIMA is DoD's Functional Manager for imagery, imagery intelligence, and geospatial information

NIMA has broad Functional Manager responsibilities, as follows:

- **Maintain vision and plans** for the USIGS. NIMA, in collaboration with the intelligence and defense communities, develops and maintains the national vision for imagery, imagery intelligence, and geospatial information. It is also responsible for implementation of this vision through development of plans, policies, programs, architectures, and standards.
- **Establish programmatic guidance** within USIGS, from which a forum will assist NIMA in articulating and setting priorities for program requirements. NIMA will develop cost and schedule impacts against an approved baseline. NIMA will then allocate available resources to priority requirements. NIMA will coordinate this process with the overall planning, programming, and budgeting systems (PPBS) of the USIGS. The USIGS will continue to identify and evaluate shortfalls and review remedies with accompanying cost and schedule to gain a greater degree of understanding and consensus on what is truly “affordable.”
- **Facilitate establishment of doctrine**. NIMA leads efforts in Joint geospatial doctrine and assists Services in establishing their doctrine.
- **Manage requirements** for USIGS information, products, and services. NIMA will manage requirements through a networked interactive process that accelerates the rate at which needs become requirements, are validated, and are then met.
- **Provide for interoperability**, which includes the data model, standards, and interface specifications for USIGS.
- **Research, develop, acquire, and integrate technology-driven solutions**. Rapid technological progress in and commercialization of geospatial capabilities requires that NIMA lead in articulating information, services, and technology investment strategies. These strategies will help make USIGS a smart buyer of information, products, and services. They will also focus on the spiral development of enhanced operational capabilities in order to maintain the information edge. Section 2.5 expands on techology needs of this CONOPS.
- **Provide geospatial training and education** for the USIGS, a continuing function to be guided by a geospatial training forum led by the NIMA College.

2.2.2 Manning

NIMA will continue to forward-deploy liaison personnel, technical representatives, Customer Support Response Teams, and technical personnel as part of National Intelligence Support Teams in accordance with Joint Staff J2 Crisis Federation CONOPS-stated arrangements. These forward-deployed personnel provide a significant contribution to NIMA's customers by providing on-site responsiveness with the ability to reach back for support when required.

2.2.3 Doctrine

Joint and Service doctrine requires frequent update to keep pace with the rapidly changing capabilities of the USIGS. NIMA will assist the military Services as they revise their doctrine to ensure that their efforts are synchronized across USIGS.

2.2.4 Education and Training

NIMA and its mission partners, through a collaborative process, will invest in the education and training programs needed to implement the USIGS geospatial transition. This investment will address the needs of all who utilize geospatial information in the execution of their mission.

Leaders and decision makers will need to understand the power of digital geospatial information and how to integrate it into their analytical environment. Operations personnel will need to understand how to establish requirements for geospatial information vice products. They will require training to access, retrieve, evaluate, visualize, analyze, and fuse geospatial information for a diverse set of needs. Existing production personnel will need to transition to become information and service providers. Technical personnel will need to maintain the expertise required to keep pace with advances in science and technology.

The NIMA College will identify a core set of geospatial tasks that cross all of these areas. The college will then assess available methodologies for delivering the training needed to perform these core tasks. Requirements for mission-specific training will remain the responsibility of each USIGS organization. The NIMA College will continue to provide military occupational training and assist in developing and delivering geospatial education through existing military, national, and international training institutions. When circumstances permit, mobile training teams will help get needed training to a larger base of people at reduced costs over bringing students to the schoolhouse.

As Joint and Service doctrine evolves, NIMA will lead a Community Geospatial Information Training Council to coordinate education and training support. As an oversight body, the council will review the core and mission-specific tasks requiring instruction and assist NIMA in the "racking and stacking" of training requirements. This body will search for opportunities to improve efficiency and effectiveness of training. NIMA will also consolidate USIGS training requirements and solicit supporting funding from other interested organizations to get the most out of each government training dollar.

2.3 Customers of Geospatial Support

Simple two-dimensional maps and charts served well for controlling the common tactical picture of yesterday

People have used standard hardcopy maps and charts for hundreds of years. Hardcopy maps and charts have served the military command and

control authority well as a simple base for the common tactical picture and as a simple framework for controlling and disseminating updates. The familiarity and inherent simplicity of standard maps or charts makes many geospatial customers nervous about digital geospatial information in an unconstrained and chaotic web environment.

The knowledge, skills, and abilities needed to work with digital geospatial content differ significantly from the skills needed to produce, print, distribute, and use maps. The new technology, though, brings new power. Many customers are realizing that the improved accuracies and intelligence value embedded in digital geospatial information, as illustrated in Figure 13, can be a force multiplier.

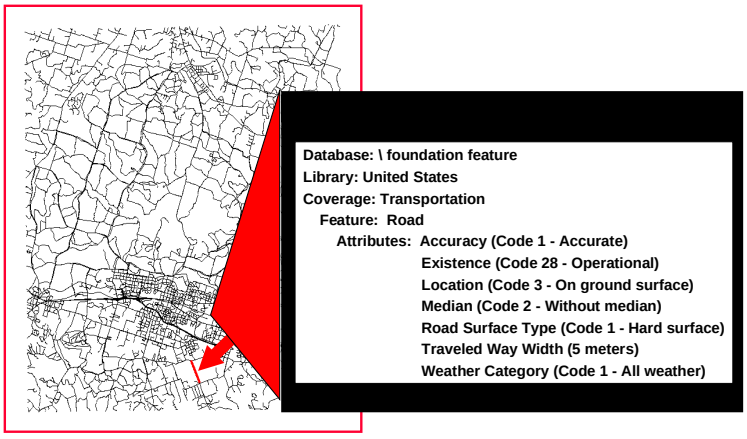


Figure 13 – Embedded Content in Digital Geospatial Information

2.3.1 Decision Makers

Decision makers from the national to the tactical level require actionable advice along with an indication of trust to make informed decisions. These customers will use a wide range of visualization, navigation, targeting, and advanced decision support systems that all depend on geospatial content for context and positional accuracy. The resulting actionable advice will be based on integration, deconfliction, and analysis of information derived from a wide range of sources. Information that is spatially referenced will be fused into an integrated view of the mission space laid out against a foundation of accurate, timely, and relevant geospatial information. These customers will benefit from the enhanced power of digital geospatial information as it applies to the CROP and to achievement of decision superiority.

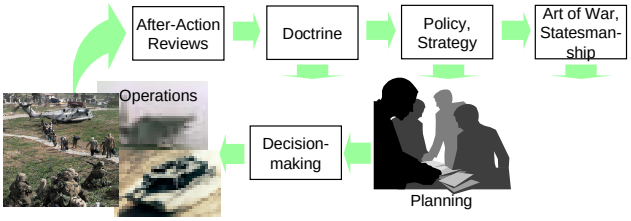


Figure 14 – The Decision Maker

2.3.2 Supporting Staff

Not all decision makers have supporting or technical staffs. However, supporting staff, when available, consists of functional experts who work collaboratively to develop actionable advice for decision makers. Supporting staff integrate information across

functional boundaries (e.g., weather, logistics) to enhance their understanding of the mission space and to develop alternative courses of action. This integration occurs through fusion of information spatially referenced to a shared framework of trusted geospatial information.

These customers have access to technical staff to help them with more complex analytical problems that geospatial information can support.

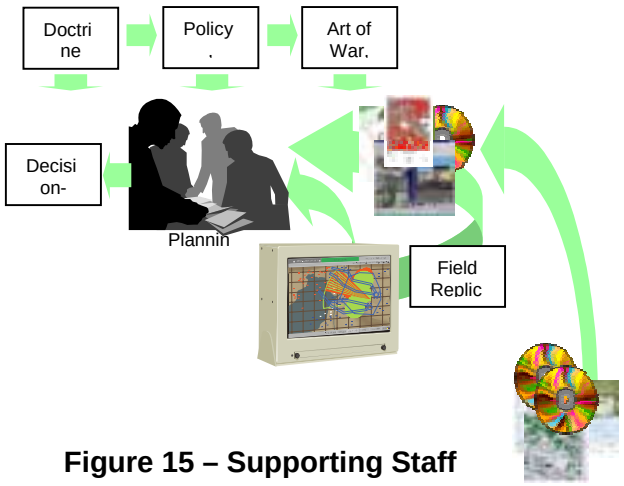


Figure 15 – Supporting Staff

Critical to success here is the need to understand how to fuse and translate information into predictions and actionable advice the knowledge on which to base decisions. Supporting staff must know when to ask technical staff for updated information, predictions, and the level of confidence in those predictions. Geospatial analysts will assist these customers in applying geospatial data as a force multiplier for their respective operational mission areas.

2.3.3 Geospatial Technical Staff

This level of customer will use geospatial data and manipulate both objects and attributes to support their analyses. These customers have the technical knowledge to identify specific objects and/or attributes necessary for a mission or tasking. They are also trained to assist others in getting the most out of their geospatial information through the use of visualization tools and advanced decision support systems.

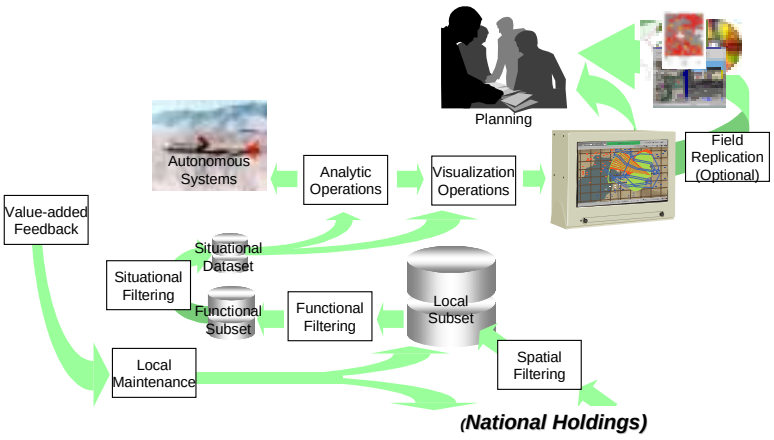


Figure 16– Geospatial Technical Staff

The new digital environment will require that customers know more about geospatial information. Technical staff will need to understand how to rapidly and intelligently gain access to geospatial information holdings of the USIGS. A working knowledge of metadata (e.g. lineage, accuracy, and intended use) will be essential to proper application of geospatial information. For example, location-based devices that utilize GPS technology will provide the coordinates of a specific location. However, when that location is spatially referenced with other geospatial information, the accuracy of the location is only as good as the GPS coordinate and the accuracy of the geospatial information. It is only through the metadata

that customers can understand the accuracy of the base information. The Internet will allow the entire USIGS to access and harness the availability of national, international, and commercial data stores. Geospatial technical staffs will require education and training to make the most efficient and effective use of digital geospatial information in support of decision makers and their staffs.

Geospatial technical staff are the front line of assistance for training and technical support in geospatial matters for decision makers and operators. Figure 16 depicts the contribution of the technical staff to the decision making process.

Tools of the Geospatial Technical Staff

Experienced, well-equipped geospatial analysts will rapidly and intelligently access, discover, and retrieve digital geospatial information across a heterogeneous network of systems. They will understand the implications of data content, metadata, and exchange standards. They will integrate and use information to visualize the mission space as two-dimensional static or dynamic displays (e.g., motion video), three-dimensional perspective scenes (e.g., urban site models), and four-dimensional representations over time (e.g., battle damage assessment). As required they can prepare hardcopy output for use by a broader base of customers.

Geospatial technical staff will perform analyses that will result in actionable information such as combined obstacle overlays, line of sight overlays, and cross-country mobility models. Three- and four-dimensional visualizations will be used for mission planning and rehearsal. When integrated with other mission-related information, analysis of geospatial information will support intelligence preparation of the mission space and course of action development. High-end customers will be able to simulate the results of decisions and predict potential outcomes. They will be able to establish terrain analysis search parameters needed to develop predictive models. Accordingly, tools for visualization, analysis, targeting, fusion, and replication must reflect this range of sophistication.

To facilitate interoperability, NIMA will deliver the commercial version of the Joint Mapping Tool Kit or its successor that will operate within the Global Command and Control System Integrated Imagery and Intelligence (GCCS-I3) environment as well as the command and control environments of the military Services. In addition, NIMA will make available standalone Geographic Information System (GIS) capabilities either at reduced cost or through such no-cost programs as the current Falconview software. NIMA, in collaboration with its mission partners, will continue to evaluate commercially available tools that may enhance the production, interoperability, and exploitation of USIGS information, products, and services.

USIGS organizations will continue to acquire and develop mission-specific applications. Developers of government extensions to commercial tools and mission-specific applications may see the potential for broader community use of their modules and nominate them for evaluation, certification, and re-use through the formal identification, assessment, and clearinghouse process managed by NIMA for USIGS.

Tools for the geospatial technical staff cover the major functions of visualization, analysis, targeting, fusion, and replication, as follows:

- **Visualization** is the primary means by which humans interact with geospatial information and the results of analysis. Advances in commercially available visualization applications will automate geospatial information content selection based on customer-selected criteria, feature symbolization and names placement needed to generate views, and the generation and labeling of contour lines. Automated finishing routines will generate associated marginalia as well as the raster image files that feed presses, remote replication devices, or workstation printers.
- **Analysis** turns geospatial information into knowledge and predictions useful to humans in decision making. Analysis also generates many specialized datasets that support specific information needs of decision makers and advanced weapon systems.
- **Targeting** benefits from geospatial support through greater accuracy in target selection, positioning, and identification of "no-strike" zones. Greater accuracy of delivered ordnance translates into greater efficiency and effectiveness as well as reduced collateral damage.
- **Fusion** brings spatially referenced information content together using the trusted framework of geospatial information as a foundation. An integrated view of operating space, created by fusing conventional, multi/hypermedia, text and graphic reports, maps, and other intelligence data, allows a decision maker to see all pertinent information in context.

Fusion brings content together and serves as a force multiplier

- **Replication** (digital and hardcopy) serves to provide a physical medium for information transfer. As applications and networks become more sophisticated, customers will utilize more local printing capabilities because they can tailor the geospatial information content to their specific needs. However, the capability to print locally will vary greatly. At the high-volume end will be NIMA's large-scale printing and replication services. At the mid-range, NIMA will deploy large-format remote replication devices. These devices can build or receive tailored views of the battlespace and produce tens to hundreds of copies per hour. Manning of remote replication systems will be in accordance with negotiated Memoranda of Agreement between NIMA and the supported customers. At the low-volume end, printers will be connected to command and control systems and stand-alone computers.

NIMA is committed to continuing production of high-volume hardcopy and other media

2.3.4 Reach-back for Technical and Training Assistance

Customers can reach back to technical specialists, NIMA, or the training infrastructure

NIMA geospatial analysts perform much the same function as the geospatial technical staffs described above. They support the translation of information needs into specific search and exploitation criteria for geospatial information. They focus on tailoring geospatial information, fusing geospatial content with NIMA imagery and imagery intelligence products, and providing issue analysis. They concentrate on knowing the region, the customer, the operation and its changes over time, and critical timelines. They identify and evaluate geospatial information available from external sources and integrate approved content into the trusted geospatial information framework. NIMA's geospatial analysts will also produce geospatial information when

required. Further reach-back into NIMA can yield assistance with specific geospatial issues such as targeting support, geophysical models, and safety of flight and marine navigation. This reach-back can also prompt scheduling of NIMC mobile training teams to satisfy organizational training needs.

2.3.5 Information Management

NIMA will provide local access to integrated imagery and geospatial information through USIGS Image Product Libraries (IPLs) and Command Information Libraries (CILs). These libraries will be linked to the NIMA Integrated Information Library.

In addition, customers may choose to develop and implement local geospatial data storage and maintenance capabilities that facilitate their immediate access. In order to ensure interoperability with USIGS data, local databasing schemas must derive from the UCDM/UEDM.

Appendix B provides the notional information architectures of the Services. New geospatial information or updates to existing information will be available through several methods. First, customers with network access will be able to "pull" information as needed from NIMA-deployed libraries or the NIMA portal. Other customers may establish "profiles" that will result in the "pushing" of new or updated information content from the NIMA portal. Customers without network access may be required to rely on satellite broadcast. Customers who depend on satellite broadcast will need to understand that there will be competing priorities and develop the capability to receive and filter information relevant to their mission. (See Appendix D – Responsiveness Strategy and Bandwidth). In addition, geospatial information on physical media and available through standard logistics networks will continue to be updated as required.

2.3.6 Protection of Geospatial Content

To protect transfers and prevent the disclosure of sensitive geospatial information and possibly its sources, it is necessary to impose restrictions. Restrictions are the hierarchy of control and release measures applied to protect information from unauthorized disclosure.

They preclude compromising operational security or collection means, and comply with other controls, such as those on replication, imposed through agreements or licenses. Properly utilized, restrictions are both useful and necessary. Used improperly, restrictions inhibit and diminish effective geospatial support.

Restrictions can take many forms. As illustrated in Figure 17, they include security classifications, compartment centers, statutory protection, and dissemination control.

NIMA operates under the general principle of providing imagery and geospatial information to its customers at the lowest security classification possible, consistent with national security requirements. NIMA also has many agreements with commercial firms and other nations to protect against unwanted disclosure to third parties, to protect intellectual property rights, or for other reasons.

Clearly, security classifications are required, particularly on source materials. Classification of source materials is often required to protect sources and methods. As processing and extraction activities turn data (pixels) into information (features), traceability

to sources and methods diminishes. However, as information is turned into knowledge and actionable advice, it picks up operational security implications. The very existence of

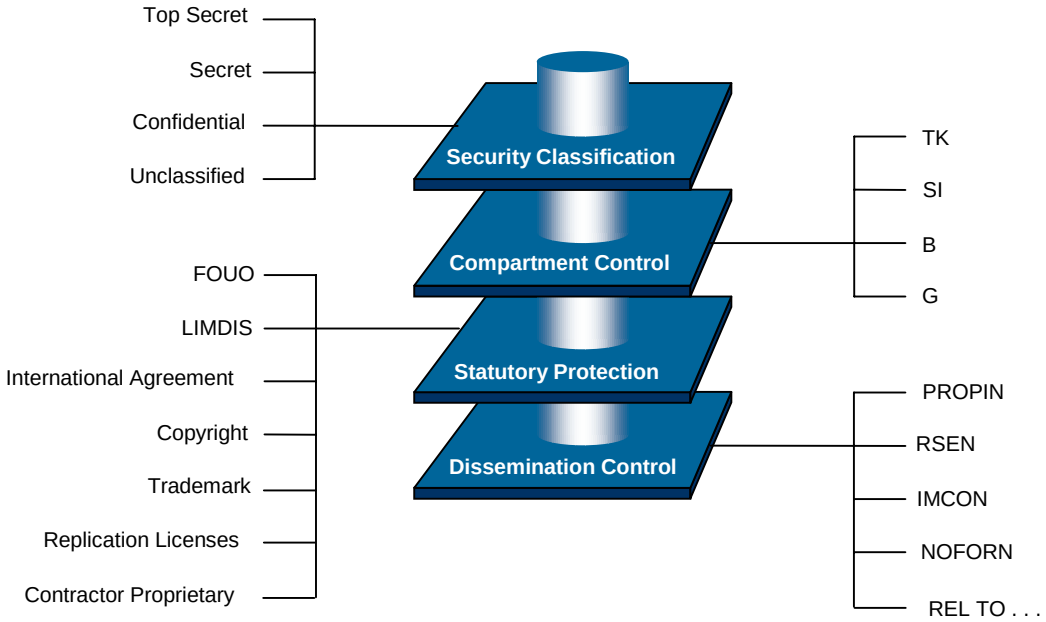


Figure 17 – A Taxonomy of Restrictions

a combined obstacle overlay or a line of sight analysis may in fact pose operational risk.

Consequently, USIGS organizations must address operational security (OPSEC) issues associated with geospatial information as part of their mission and functions.

The fewer the restrictions, the better will be the potential for collaboration across the entire producer and customer community. Experience in industry, even among competitors, has been that the advantages of sharing information far outweigh the risks of disclosure.

When restrictions are necessary, they should work smoothly and reliably. Technological advances in multi-level security will allow much more efficient databasing while still ensuring protection of sensitive information. These advances will also reduce the content synchronization problems associated with having the same content replicated in holdings at multiple classification levels. Advances in customer identification and secure communications, such as Public Key Infrastructure (PKI) certificate issuance throughout DoD, will help ensure that only the right people get access. Advances in data generalization and filtering will support on-the-fly creation of data sets with reduced classifications or release restrictions from much more authoritative but sensitive master holdings.

2.3.7 Information Access, Discovery, and Retrieval

Customers will access, discover, and retrieve geospatial information in a web-based environment. Web-based technologies will provide not only rapid and intelligent access to the geospatial information holdings of the USIGS but also provide basic geospatial services such as datum transformation and data exchange services. Web registries will be developed to facilitate the interoperability of geospatial information content across

heterogeneous networks regardless of native format. NIMA will develop web registries for the USIGS based on the UCDM/UEDM.

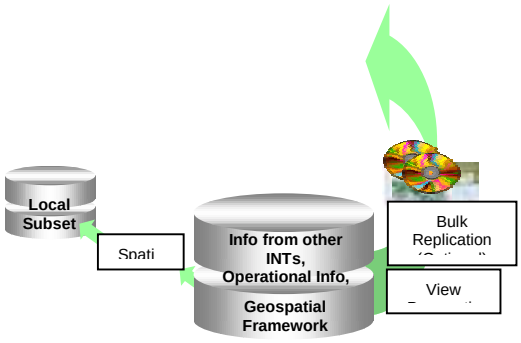


Figure 18 – Master Holdings

NIMA's geospatial information will be organized by area of coverage, country, thematic content, and operational context (e.g., crisis or exercise).

Customers will also be able to geolink information available from multiple information service providers. The ability to geolink spatially referenced information dealing with a single area or issue will reduce search times and provide more intelligent access to the vast stores of information that will be available in the 2010 timeframe.

2.3.8 Geospatial Information Content

- **Global Readiness**

NIMA is committed to providing a near-global foundation of geospatial information. NIMA will populate and maintain components of the foundation in accordance with mission priorities of its customers.

FD consists of the components illustrated in Figure 19.

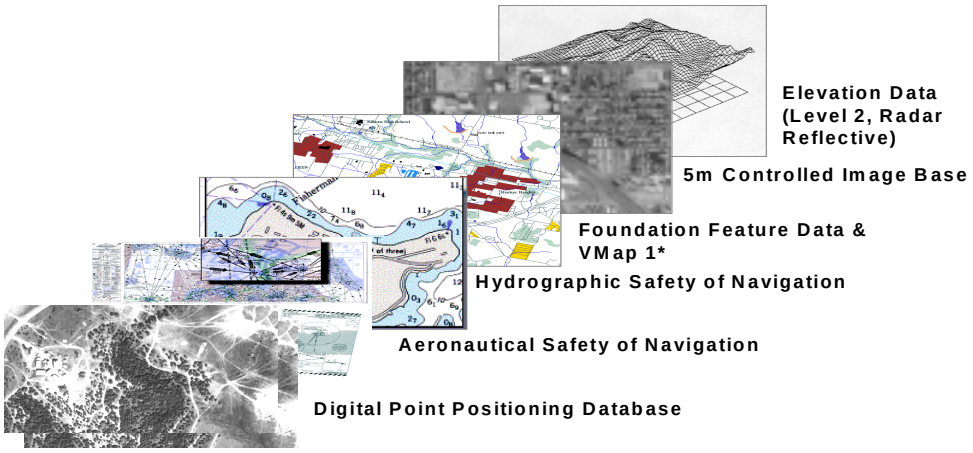


Figure 19 – Foundation Data Components

* As Foundation Feature Data becomes available, VMap1 will be eliminated

The components of FD can be used individually or in combination with the right tools and training. They can support two- and three-dimensional views of the mission space as well as provide the analytical detail needed to support initial operational planning. Foundation data supports the types of functions shown in Figure 20.

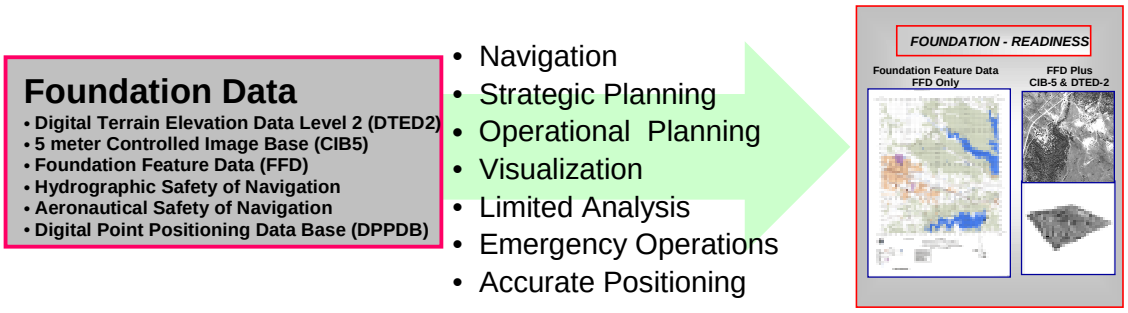


Figure 20 – Output from Foundation Data

■ Mission-Specific Data

Mission-specific data is higher-resolution imagery, elevation, and feature data as well as the results of geospatial analysis. Mission-specific data:

- Focuses on an objective area,
- Is more situational and mission-relevant than FD,
- Increases the level of feature density, attribution, and/or accuracy,
- Is content driven,
- Considers the more temporal aspects of the environment,
- Is based on intended use, and
- Provides interoperability across organizations, missions, and systems.

Mission-specific data is generated not only by NIMA but also by all USIGS organizations in the execution of their mission and functions.

A standard MSDS data content specification defines an agreed-to profile of features and attributes needed to support specific mission requirements based on intended use. NIMA, in coordination with its customers, will have defined five basic environments (air, land, urban, littoral, and ocean) at multiple levels of information density that constitute standard MSDS. Within each MSDS profile, the agreed-to data content will support a variety of different functions such as those shown in Figure 21.

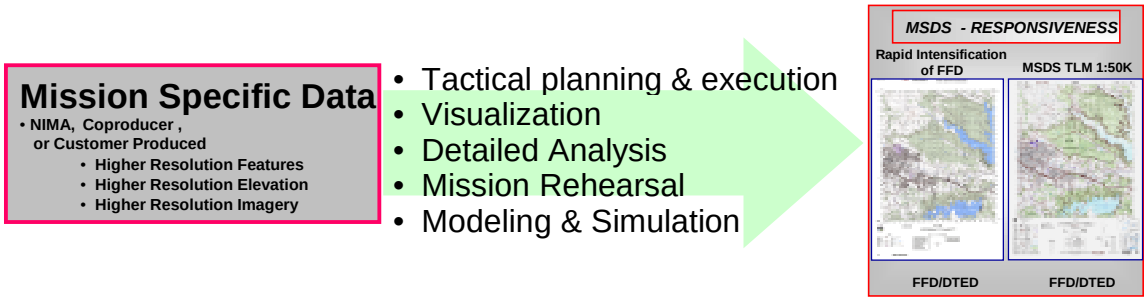


Figure 21 – Functions Supported by Mission-Specific Data Sets

The development of standard MSDS seeks to:

- provide the uniformity needed to facilitate training across a broad audience,
- establish a means to convey coverage, content, and density requirements efficiently,
- ensure interoperability and uniformity across forces, missions, and systems,
- maximize reuse of data across the air, land, urban, littoral, and ocean environments, and
- facilitate transition from standard hardcopy products to an open geospatial information environment.

Tailored MSDS can include customer-specified imagery, elevation, and feature data that deviates from a standard MSDS specification. Tailored MSDS will be more temporal in nature, mission-sensitive, or for analytic use to satisfy a unique information need. Tailored MSDS usually addresses a very limited audience with a focused mission.

Value-added content, once accepted and integrated, becomes part of the trusted framework

Other USIGS organizations will apply mission-specific data to their operations or continue to add value to its content. Value-added content can then be sent back to NIMA for evaluation and, if approved, integrated into its master database. Customers will provide value-added content back to NIMA as nominated additions or changes. NIMA may host nominated data changes for access and use by other customers pending further processing. NIMA's geospatial analysts will assess and verify the quality of the information contained in the new data sets. Subsequently, NIMA will integrate suitable data into its geospatial framework as authoritative content.

2.3.9 Portal Operations

At the national level, NIMA will populate the NIMA Integrated Information Library (NIIL) with imagery, imagery intelligence, and geospatial information. Customers will access these data stores through local services such as an organization's intranet or externally through web-enabled services across global secure communications networks (Joint Worldwide Intelligence Communications System – JWICS, Intelink, Secret Internet Protocol Router Network – SIPRNET, Non-Secure Internet Protocol Router Network – NIPRNET, etc.).

NIMA will replicate data between sites based on security classification levels until an integrated multi-level security environment matures.

NIMA will provide a portal through which customers can access, discover, and retrieve the geospatial information holdings of the USIGS. This will require that participating USIGS organizations adhere to metadata standards and register their holdings with the NIMA portal.

Portal customers may also establish profiles. These profiles will be used to customize geospatial information and services available through the NIMA portal. Such services can include the registration of their related Public Key Infrastructure (PKI) certificate data. The Public Key Infrastructure will provide a variety of services (i.e., data integrity, user identification and authentication, user non-repudiation, data confidentiality, encryption, and digital signature) for programs and applications that use DoD networks. Certification will allow customers with standard Internet connections to access unclassified portions of the NIMA portal. For many customers, access to NIMA's unclassified but distribution-limited data via the Internet will be a significant and revolutionary step.

NIMA's portal will also provide access to core visualization and analysis tools. Customers may download those tools or use the portal to launch a service that uses the tools. With this service, customers can select both operations to be performed and information to be used. Customers can then download resulting displays or processed datasets.

Customers will be able to initiate simple queries for geospatial content from their networked systems without necessarily knowing or caring where the actual data content resides. Such a query may include:

- by-name regional and country-specific inquiries,
- requestor-defined areas of interest, as regular or irregular polygons created through simple on-screen operations,
- specific coordinates,
- standard views,
- intended use,
- scale and/or data density and resolution,
- data type (raster, vector, text, matrix, voice, video),
- geographic names,
- date ranges,
- accuracy ranges,
- currency ranges,
- key words (e.g. transportation, weapons of mass destruction) and/or plain English queries, or
- dissemination restriction information (e.g. security classification, releasability, copyright).

Responses to queries will consist of thumbnails of available data with a plain-English description of the associated metadata. Customers can then select specific content for retrieval. Customers can choose from a variety of sources, formats, compression algorithms, and media, with default selections determined by a user profile if available.

Customers will have many options for obtaining the data they select. NIMA will provide a range of delivery services including orders for standard physical media through the DLA, third-party reprinting, in-house downloads onto a physical media, and direct download to the requester.

The portal will allow independence of the master holdings from the formats used to transfer content to requestors

For online exchange of geospatial information, the portal as well as other web-enabled servers will offer a variety of services, including file format or data structure conversions. Required conversions will vary over time based on customer needs.

Supported raster and vector formats will continue to include military, international, and standard commercial formats. NIMA's Vector Product Format (VPF) will migrate to an interoperable suite of open international and commercial data exchange standards based on web-enabled services. By 2010, open feature-level data exchange standards through data tagging will allow customers to migrate away from specific military and commercial file implementations.

Web-based transactions with NIMA at its portal will evolve toward an e-business model that allows NIMA to:[8]

The portal will also enable transition to e-business practices

- provide greater access to NIMA library holdings with intuitive and robust discovery, retrieval, and presentation capabilities,
- provide robust feedback to customers about the status of their requirements (including orders, taskings, and requests for source collection, content generation, product presentation generation, tool generation, and services),
- promote fluid exchange of tools, sources, and concepts across the enterprise, helping it to self-organize—that is, to dynamically adapt to changing mission needs,
- offer collaborative sessions with NIMA experts for needs analysis, content maintenance, view generation, and production request clarification,
- post answers to frequently asked questions and provide HELP services,
- advertise its products by pushing news about them to interested subscribers,
- advertise ancillary services such as training and new applications while delivering these products and services over the same media,
- use hot links on its own products to allow users to click through to substantive collateral materials,
- embed context-sensitive training and educational materials within NIMA products,

[8] List adapted from Report of the Independent Commission on the National Imagery and Mapping Agency, December 2000, p. 33

- create hot links between other spatially-referenced intelligence information, NIMA's geospatial holdings, and DLA's ordering gateway to facilitate ease of access,
- permit qualified geospatial commodity vendors and value-added suppliers to market to the national security community through NIMA as a broker,
- encourage commercial vendors to make their own archives accessible on-line from Government networks,
- solicit and accept feedback on products and services,
- accept and utilize value-added submissions,
- facilitate loan programs (loan equipment in exchange for collected data), and
- facilitate change notification as set in user profiles.

2.3.10 Establishing Geospatial Requirements

The area requirements process will get faster and more flexible while preserving accountability

Customers will submit geospatial information queries through the NIMA portal for available information. If customers cannot find the information they need to support operational planning or execution, they can generate a geospatial information need. Geospatial information needs will be routed on-line through the Command, Service, or Agency approval chain for clarification, validation, and prioritization. Validated information needs will become formal requirements for data acquisition or production.

As part of the deliberate planning process, military planners will develop a set of geospatial information needs based on intended uses required to execute a given plan. The intelligence community develops similar information needs in response to their mission requirements (e.g., threat analysis, surveillance). NIMA customer support personnel and geospatial analysts will work closely with mission planners to better understand the intended use of the geospatial information based on mission needs to include mission objective, forces, weapons platforms, and systems that will be involved. These intended uses, in combination with other mission information, will determine the appropriate formal requirements and priorities for foundation and mission-specific data.

NIMA personnel will provide resource estimates, timelines, and possible alternatives for satisfying the requirements. In addition, NIMA personnel will assist planners in determining their readiness based on the level of operational risk that is acceptable considering the utility of existing geospatial holdings and NIMA's ability to respond. To facilitate this interchange, the geospatial information requirements process will evolve to become more dynamic, collaborative, and responsive to the needs of both the intelligence and military communities.

2.3.11 Generating New Content at Forward Sites

Content created at forward locations for local use will have value to others and will be shared as value-added content

Many customers of NIMA data will generate or acquire geospatial information locally. Army and Marine Corps terrain teams will collect, generate, and integrate high-resolution geospatial information using theater and local assets. The Air Force's Air

Operations Center (AOC) Battle Damage Assessment (BDA) cells will also generate more temporal geospatial information as they execute their operations. Naval ships with electronic chart display (ECDIS-N) will collect high-value and highly accurate depth information. Customers may also acquire data from other governments or commercial firms, obtain support from geospatial assets of host nations, extract geospatial information from imagery (commercial, tactical reconnaissance, or national), filter the flow of combat information for geospatial content, or conduct personal reconnaissance to augment content they receive through the USIGS.

Most of the locally-collected content supports specific current missions. It may, however, have value to others as field checks, corrections, updates, amplification, or densification of existing data. This is potential value-added content. Local data managers must ensure that new geospatial content they handle carries the metadata that will also allow its insertion into the value-adding process.

2.3.12 Sending Back New Content for Reuse

Value-added content, once accepted and integrated, becomes part of the trusted framework.

Customers will develop and implement validation processes for providing value-added content back to NIMA. Validated content will be sent to NIMA through the portal as nominated changes. As described in section 2.3.8, NIMA may host nominated data changes for access and use by other customers pending further processing. NIMA's regional teams will assess and verify the quality of the information contained in the new data sets. Subsequently, NIMA will integrate suitable data into its geospatial framework as authoritative content.

2.4 Providers of Geospatial Support

The USIGS will transform the legacy geospatial infrastructure that was designed and engineered to create pre-packaged geospatial products to one that is focused on providing the information and services needed by its customers. To facilitate this radical change in operations, extensive training will be required by customers as well as by producers of geospatial information.

2.4.1 Training/Skills for Deployable Geospatial Technical Support

How NIMA provides support will evolve in response to usage patterns and customer requests

NIMA has and will sustain an active program of deploying liaison officers, geospatial analysts, customer support response teams, and technical representatives to Commands and Agencies where they can assist organizations in requesting and using geospatial information, products, and services. These deployable personnel must have the relevant knowledge, skills, and aptitude to learn the supported organization quickly, interface with the customer, understand relevant policies, and apply USIGS capabilities to customer problem sets. NIMA and the supported organizations provide needed training.

2.4.2 Training/Skills for Coproducers

International, national, commercial, and academic organizations may enter into agreements with NIMA to be geospatial coproducers. As such, they agree to generate geospatial data in accordance with approved standards. Although coproducers normally are responsible for their own training, NIMA may offer supplementary training via the NIMA College.

2.4.3 Training/Skills for NIMA's Geospatial Workforce

NIMA acquires and generates the trusted framework of geospatial information. As NIMA progresses to becoming an information and service provider, NIMA's workforce must acquire the knowledge, skills, and abilities to be "smart buyers" of geospatial information, to rapidly generate mission-specific data, manage the digital infrastructure, and maintain NIMA's geospatial databases. They must also learn to integrate geospatial information with imagery and imagery intelligence operations (Figure 22). It is in this integration that synergies will accrue, thereby improving NIMA's ability to provide the information edge. The NIMA College will continue to provide the education and training programs that sustain a world-class workforce.

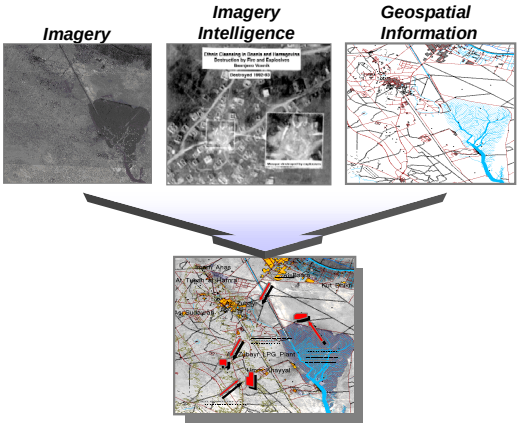


Figure 22 – Integration of the Disciplines

2.4.4 Cross-Training of Intelligence Analysts

Cross-training of other intelligence analysts in geospatial skills will provide synergy that enhances their jobs

Analysts throughout the extended intelligence community deal with issues that generally have a spatial context. Many of these analysts are learning about the power of geospatial information and applications that can support their activities. They are also learning more about how to obtain and use geospatial information and analytical tools in their own work. By 2010, the NIMA College will have developed and be conducting the appropriate cross-training in geospatial information needed to operate in a true multi-INT environment that is spatially referenced.

2.4.5 Providing Access to Holdings

NIMA will remain the primary point of entry for customers seeking one-stop access to USIGS' geospatial information and services. NIMA will serve as an information broker for geospatial content registered with NIMA but held elsewhere. It is therefore NIMA's responsibility to provide the infrastructure that will allow authorized customers access.

NIMA will acquire, populate, maintain, manage, and assure access to the trusted geospatial framework that underlies the work and capabilities of the entire USIGS, as illustrated in Figure 23.

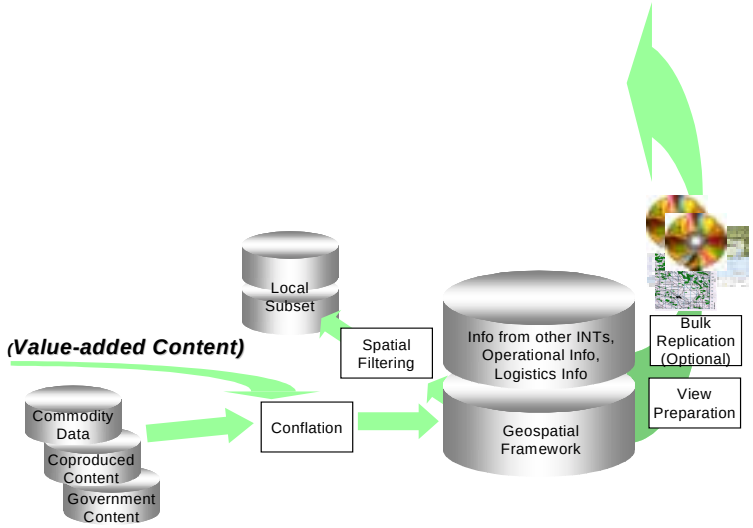


Figure 23 – Access to the Trusted Geospatial Framework

NIMA is the lead within the USIGS to enable acquiring, generating, fusing, storing, and maintaining geospatial content. Other USIGS organizations may also acquire geospatial content and make it available to their organization, as well as to USIGS. In some cases, organizations other than NIMA should hold and be responsible for essential geospatial content on behalf of the USIGS. This could potentially include the data warehouses of commercial imagery and geospatial information providers via brokered websites.

NIMA will invest in the knowledge tools that will allow rapid access to the right information, at the right place, at the right time. This includes providing intelligent access through smart portal technologies so customers can easily access, discover, and retrieve geospatial information they need. Portals learn from transactions, building profiles of customers to enable smarter exchanges on information needs and availability. Customers who know what missions or functions they will perform but have little geospatial expertise should find it easy to access, discover, and retrieve available geospatial information.

The portal will serve up trusted content, connect to other sites, and track usage patterns to improve service

Registered USIGS geospatial information providers will establish agreements with NIMA to make their information holdings available through the NIMA portal. These agreements will identify the protocols that all will follow to ensure interoperability across a heterogeneous network of both servers and systems. The agreements will also establish quality standards and provide for labeling (associated metadata) so customers can understand what they get in terms of quality, accuracy, and completeness. The NIMA portal will use available commercial technologies as much as possible. For example, by 2010 registered mobile JAVA scripts will allow significant advances in information access and retrieval capabilities, along with dissemination of software applications with the required information. NIMA, in its role as Functional Manager for geospatial information, will provide the guiding policies and processes needed to coordinate implementation.

Through the development and use of profiles, NIMA's portal operations will be able to collect or maintain information about customers. Profiles will include information about the customer needed to provide timely information, products, and services. Many customers have a requirement to automatically receive new and updated information in their area of interest based on selected options within their profile. For example, customers routinely interested in geospatial information in a specific area of interest can choose to

automatically receive updates via smart push. Others who do not wish to receive automated updates for operational or security reasons will be able to exclude themselves from this service through their customer profile. These customers can then choose to pull the new information updates from the NIMA portal. Customer profile information will be protected from unauthorized access.

NIMA will hold a minimally redundant, authoritative, and dynamically maintained digital counterpart of the real world

NIMA will provide customers with access to imagery, imagery intelligence, and geospatial information holdings. These holdings will be managed through a set of logically integrated but physically distributed databases storing raster, vector, matrix, video, text, and voice data. NIMA's feature database will be a seamless object-based data storage and maintenance environment, independent from planned data exchange formats. As an object, each feature will occur once within the NIMA database, with any attribution needed to support the full range of potential applications, including changes in state over time. Customers can access features individually or through prescribed views or coverages, and can link to other USIGS data stores through the features.

Dissemination of content on physical media will continue

In addition to providing information access via existing networks (NIPRNET, SIPRNET, JWICS, Intelink, OSIS, Internet through the use of Personal Key Infrastructure technologies), NIMA will disseminate newly available and updated geospatial information via a number of alternative strategies. Access to and dissemination of releasable USIGS geospatial information holdings will also be achieved through other approved communications networks that support coalition operations. Geospatial information available on physical media will be disseminated initially via subscription and then through an order entry system at the NIMA portal. DLA (and independent contractor services) will continue to process subscription shipments and process requisitions for physical media. However, by 2010 the requirement for physical media is expected to lessen in response to an increase in digital access and retrieval through networks.

Digital access, dissemination and retrieval of critical data will increase while the demand for hardcopy is expected to decline

NIMA will use existing broadcast services to disseminate new and updated information. Broadcast services will decrease customer reliance on existing and future landline services where contention for bandwidth will remain extremely high. NIMA will ensure broadcast of new and updated information to a theater regularly during non-peak hours. For raster and vector data, NIMA will provide the automatic capability to update information contained in local data stores. Patches of raster data will update larger imagery files. Vector updates replace (or augment with higher density data) existing features and attributes within a coverage. Vector data updates will preserve the topological integrity of data.

2.4.6 Managing Tools

USIGS will acquire new geospatial tools from industry and certify and share common tools

NIMA will continue to acquire software tools that provide common capabilities to many users. NIMA will also continue to sponsor programs that allow the

USIGS to test and evaluate industry and government tools. NIMA will establish a repository of tools to promote reuse of government software, thus providing for economy and efficiency.

NIMA will continue to support commercialization and fielding of the JMTK or its successor within the Global Command and Control System Integrated Imagery and Intelligence (GCCS-I3) environment as well as the command and control environment of the military Services. Commercial standards will eventually replace existing GCCS Application Program Interfaces (APIs), creating a component "plug and play" architecture in which specific capability requirements can be competed across vendors.

NIMA will ensure the availability of standalone GIS capabilities, visualization tools, and analytical capabilities that will help customers exploit information, products, and services from foundation-based operations. The cost of these tools may vary widely, requiring community decisions as to the expected benefits and potential opportunities for cost sharing. Visualization tools in the 2010 timeframe must support 4D displays of geospatial information in combination with high-resolution imagery. NIMA will disseminate these tools via some physical media or make them accessible for download via the NIMA portal.

2.4.7 Providing Technical and Training Assistance

Customers will need to learn more about the power and limitations of digital geospatial information, often beyond what they can learn through structured or online training. Geospatial experts in producing organizations like NIMA can assist in resolving technical issues through a variety of means.

- **Deploying personnel** such as liaison officers, geospatial analysts, Customer Support Response Teams, and technical representatives to supported Commands, Services, and Agencies remains an extremely effective, direct, and personal way of delivering NIMA technical support. In times of crisis, NIMA will continue to deploy crisis support capability to the field when requested. Deployed personnel will be able to reach back into NIMA for additional support.
- **Reachback** support will be available via NIMA's geospatial analysts. These analysts will have the technical training and equipment needed to support customers and forward-deployed personnel. This support includes an in-depth understanding of the region involved, the customer, mission requirements, and critical timelines. They apply their knowledge of geospatial information to support intelligence and operational issues. In addition, they will facilitate integration and fusion of spatially referenced information from other sources (e.g., weather, logistics).
- **Collaborative interaction with experts over communications channels**, particularly the Internet, will grow in importance.
- **Hosting frequently asked questions (FAQs), answers, popular view recipes, and technical tips on websites** is particularly effective in overcoming short-term technical issues within the USIGS.
- **Providing mobile training teams for mission-critical training** can assist in meeting operational requirements and provide a rapid training capability while customers develop doctrine, training, and programs in support of foundation-based operations.

2.4.8 Creating Geospatial Views

Recipes operate on content to create views useful in decision making

In the data-centric geospatial environment of 2010, recipes will specify the geospatial information needed for digital views that meet customer needs. For example, a customer will be able to request a resolution of information equivalent to the familiar 1:50,000 topographic line map over a given area. Appropriate content will be selected from the database, symbolized, and marginalia assembled to provide a view that looks like a 1:50,000-scale map of today. The more knowledgeable customer can select specific content for use in tailored views. Metadata will accompany each view to provide quality and release restriction information. Customers should consider trying new or tailored views of existing content before establishing requirements for new production or for acquisition of data.

2.4.9 Managing Requirements

NIMA will assess requirements against the utility of existing holdings to drive data acquisition and production decisions

After formal requirements have been validated and prioritized through the agreed-to Command, Service, or Agency process, NIMA will collect and integrate requirements over a given area of interest. NIMA will then be able to correlate all information requirements for a given area to ensure that there is no duplicate production or acquisition of geospatial information.

NIMA will compare validated requirements to existing holdings to determine where shortfalls occur. Shortfalls may exist in coverage, density, currency, accuracy, and/or form. These shortfalls limit the utility of existing information holdings to satisfy the customer's intended use. NIMA will review shortfalls with the validating authority to determine precedence within existing plans and priorities.

USIGS will safeguard customer requirements at the appropriate classification level to protect operational security.

2.4.10 Assessing Information Utility

Geospatial information utility is a potential means to measure the value of USIGS geospatial holdings against their intended use. Computing information utility is a function of real-time analysis based on available metadata for selected data sets within a customer-defined area of interest. Using a simple prototype desktop software tool, NIMA has demonstrated a method

Figure 24 – Information Utility Prototype

of measuring the utility of available geospatial information based on spatial accuracy, currency, percentage of area coverage, usability of the information based on its form, and availability in a required datum. Information utility scores are automatically calculated in real-time using weighted criteria. The tool also allows a customer to change criteria weights based on specific preferences. The results of the scoring can yield information utility by overall holdings, product, or by specific coverages.

Figures 24 and 25 illustrate a notional approach to this process.

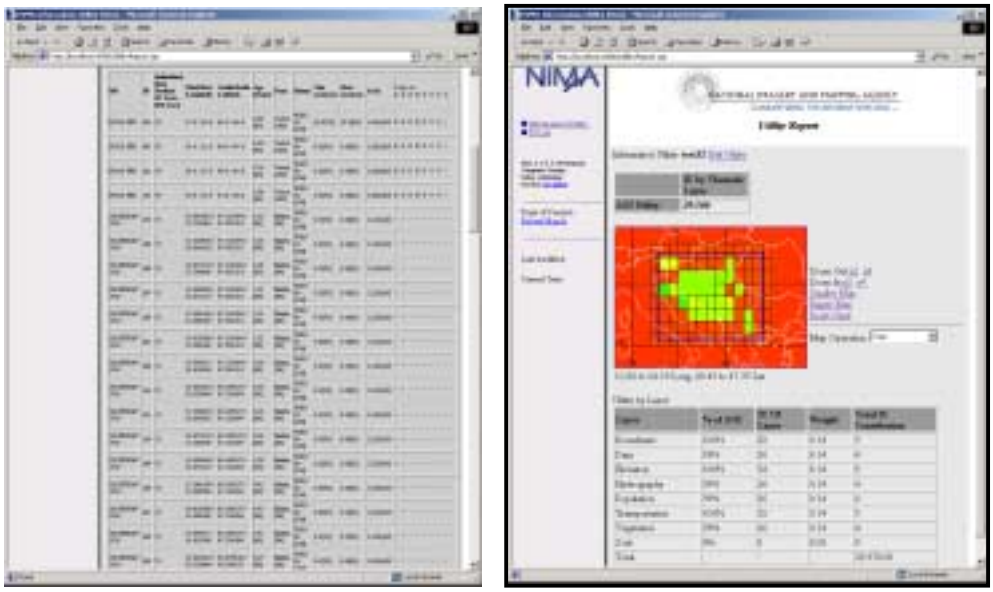


Figure 25 – Information Utility
Product Listings and Coverage Listings

2.4.11 Assessing Mission Readiness

USIGS must continue to assess mission readiness for critical intelligence missions (e.g., surveillance, reconnaissance, threat analysis, and covert actions), as well as military operation plans (OPLANs), concept plans (CONPLANs), and functional plans. As it transitions to foundation-based operations, the USIGS must begin evaluating its readiness with foundation data as well as its capability and capacity to respond with mission-specific data. Capability refers to having the needed source material, trained people, business processes, and systems to produce the required MSDS. Capacity is having the sufficient resources available to satisfy the requirement given the lead-time available.

MSDS are more perishable than foundation data. Large amounts of MSDS generated in advance of an operation can rapidly become outdated or irrelevant. Thus, NIMA and its customers need to carefully examine the need for advanced production of MSDS in support of a given plan or mission. Mission-specific data should be generated only in response to crises or when needed information cannot be generated in time to support the

operation given existing capacity. Feasibility assessments for MSDS generation must take into account the availability and currency of source materials and response times with new source if required. NIMA will continue to use its capability and capacity to produce MSDS within response times set forth by the Services through the USIGS Imagery and Geospatial Capstone Requirements Document (IGCRD) as an indicator of its readiness to support mission-specific operations.

There will never be sufficient resources available to map the world at the level of granularity desired by all customers. Therefore, NIMA will collaborate with customers to clarify and strike a balance between time and resources available, intended uses, operational risk, and available sources. NIMA will also provide near-real-time feedback to the requester identifying resource impacts and expected delivery date/time information. Disposition of these requirements may take one of several forms:

- If NIMA can satisfy the validated geospatial information requirement with minimal effort, the appropriate office will take immediate action and supply an immediate response. Normally, these types of requests will be for briefing graphics, perspective scenes, views prepared from existing geospatial information holdings, or analytical support. Forward-deployed technical representatives, Customer Support Response Teams and NIMA representatives to a National Intelligence Support Team will normally support these types of requests for information as a level of effort.
- NIMA will allocate resources based on database population, maintenance, and analytical requirements associated with global readiness, safety of navigation, and mission-specific requirements. Allocation of resources within each of these areas will be in accordance with priorities of the national intelligence and defense communities.
- As NIMA moves more into the role of information service provider, it will increasingly program geospatial information manpower more as a level of effort rather than based on current production standards.

Based on this allocation of resources, NIMA customer support and production personnel will work with the validating authorities to establish data acquisition/generation plans and to provide feedback and estimated delivery timeframes. As crises impact established plans, NIMA will provide impact assessments as required.

Currently, NIMA meets with the USIGS and the Joint Staff each quarter. Each quarterly meeting addresses geospatial requirements and status for approximately one-fourth of the existing OPLANs, CONPLANs, and Functional Plans. The cumulative result is that the Joint Staff reviews each plan once a year.

The process will change to a more timely collaboration in articulating requirements for geospatial information and in arbitrating priorities given the limited assets available. NIMA will work continuously with its customers to better understand their geospatial information needs and to respond with the right information, at the right place, and at the right time based on intended use. This interaction will be in a more collaborative environment in which authorized submitters of geospatial information requirements will work together with NIMA's operational elements to establish, manage, and report on requirements for geospatial information. NIMA will provide feedback and status to authorized submitters on a continuous basis via on-line access to a requirements management system. The Joint Staff will continue to provide annual formal review.

By 2010, NIMA will have integrated geospatial information requirements into a comprehensive capability covering imagery, imagery intelligence, and geospatial information. NIMA will work with the intelligence community in their efforts to create a fully integrated intelligence information management capability.

2.4.12 Managing Content

NIMA and other content producers will deal with many types and sources of content, such as:

- **value-added content from customers,**
- **like content from other producers** obtained as coproduction or commodity acquisitions,
- **newly extracted content**, which will require integration into existing holdings, and
- **other spatially-referenced content,** the fusion of which is a key enabler to multi-INT operations. The movement toward multi-INT operations starts with the geospatial information and imagery intelligence communities, progresses to include signals intelligence (SIGINT), and will include other INTs over time. Redundancies and inconsistencies will become apparent when holdings of other communities are brought together. Data managers can resolve these through conflation[9], but the redundancies and inconsistencies will continue until everyone agrees who has primary responsibility at the feature and perhaps attribute level. Such allocation of authority does not preclude management and presentation of conflicting opinions about objects or their attributes, processes that are essential to many intelligence tasks.

A trusted geospatial information framework will serve as a key enabler for multi-INT operations

NIMA will be the primary manager of geospatial content for collaborating providers. Content management must provide for:

- **historical records and continuity of operations,** which NIMA will accomplish through transaction management, archives, backups, and replication services where applicable,
- **trend data,** which provides the temporal, or fourth dimension of geospatial content; this is a new requirement for historical and predictive information, needed to support higher-order analytical requirements, that will introduce considerable complexity into databases,
- **shelf-life management,** a new and complex requirement which provides for systematic purging or flagging of content, perhaps down to the feature level, based on metadata and automated change detection,
- **multi-level security and operational security (OPSEC),** which have been standing content management issues with huge implications on database and network infrastructure costs as well as on response times; over-classification and over-

[9] Conflation involves identifying, resolving, and merging different renditions in spatial datasets of what is actually the same entity; conflation is a special type of fusion

protection of content can put at risk our ability to stay inside the adversaries' decision cycle, and

- **information assurance,** a standing requirement which protects the integrity of information through detection and prevention of intrusion.

NIMA's regional or issue teams will control data in work; ideally, coproducers and potential customers will be able to reach metadata about its existence and request access to the data under appropriate controls. NIMA's regional or issue teams will transfer completed data to the object-based feature database for integration.

2.4.13 Maintaining Currency

Maintenance will be driven through observed change rather than planned obsolescence rates

NIMA and its coproducers have traditionally managed currency of geospatial content at the product level, scheduling maintenance (usually recompilation) when they expect critical components of content to approach the limits of acceptable change. Such interval-based currency maintenance has limited effectiveness and efficiency. New national and commercial imaging systems, when combined with advanced change detection algorithms, now offer promise for change-based currency maintenance. Continued advances in image processing and computing power will offer greater capability to fully automate change detection as an integral element of the processing stream.

By 2004, NIMA's maritime safety information will reach a state of continuous maintenance. For land-based information, it should be possible by 2010 to drive data maintenance primarily through automated change detection algorithms using source imagery compared to reference master images. For example, Landsat 7 multispectral data is already revealing areas of change from the base Landsat 5 data that provided near-global land use/land cover information. Identified changes trigger focused updates using the new imagery. NIMA, working with its customers, will determine the relative priority of maintenance required based on regional areas. Said another way, national security and military interests are greater in some areas than others, so NIMA will strive for greater currency in those areas.

In order to satisfy these maintenance requirements, NIMA and coproducers will strive to acquire data from sources that have on-going maintenance programs.

2.4.14 Obtaining Content

NIMA will buy what we can, build only what we must, and automate as much as possible

NIMA will follow a strategy to buy what we can, build only what we must, and automate as much as possible. Orthorectified imagery and elevation data will become a byproduct of upstream processing. Three- and four-dimensional perspective scenes and site models will become fully automated, using the imagery capabilities of the Future Imagery Architecture in combination with advanced technologies.

In addition, NIMA will collaborate with the rest of USIGS to assess the availability of geospatial information from international, national, and commercial sources. Data mining and assessment will become a critical function within the USIGS. Initial indications are that

data mining could yield many potential sources for digital geospatial information. Customers will also generate value-added geospatial content and return it to NIMA for possible inclusion into the master holdings. NIMA will assess available information based on its quality, content, density, currency, coverage, accuracy, datum, data structure and format, language, maintenance, cost, and licensing or dissemination restrictions.

Resolving redundancies and inconsistencies in content from many sources creates the trusted geospatial framework

Geospatial information from non-certified providers is suspect until assessed. The assessed data may provide little information utility. Decisions regarding utility of the information will determine if it is to be acquired and made available through USIGS with the appropriate metadata to caution customers about use. Finally, some sources of geospatial information may meet all standard and specification requirements of NIMA-produced information.

During data acquisition, organizations will work with NIMA to acquire data rights to ensure access by the remainder of USIGS. Although this approach will assist in meeting coverage requirements, it may not meet all military standards and specifications, particularly for accuracy.

NIMA is fully committed to generating the near-global coverage of Foundation Feature Data (FFD). However, the current cost of producing FFD in fully-populated one-degree cells has exceeded expectations. Although NIMA anticipates a decline in cost, it will not be to the point that near-global coverage will be possible by 2010 given existing resource constraints. Consequently, NIMA will focus production of fully populated cells of FFD on high-priority operational areas and on areas needed to facilitate training on new digital forms of geospatial information. In areas of lower priority, NIMA will increase its emphasis on identifying, evaluating, and acquiring coverages from external sources. NIMA will assess these externally acquired coverages (e.g., vegetation, transportation, and drains) in terms of their quality, accuracy, and content against existing FFD requirements.

There are many sources for thematic coverages. NIMA is now working to acquire vegetation, population, and transportation coverages from commercial sources. The National Oceanic and Atmospheric Administration and the United States Geological Survey have hydrographic coverage of the continental US. The Shuttle Radar Topography Mission (SRTM) is yielding Digital Terrain Elevation Data (DTED) that shows the radar-reflective surface. The Department of Energy and oil companies may be able to provide power grids and pipeline information. New potential sources of data will emerge over time. NIMA's regional teams, working in concert with their customers and other providers of geospatial information, will identify potential sources as a primary function.

NIMA will consider new methods of generation when it cannot find suitable thematic coverages to acquire. For example, the SRTM data may yield vertical obstruction data as well as water body delineation, double-line drains, and coastlines in support of FFD. NIMA is procuring a near-global soils database, with inherent landform data, that may yield alignments of single-line drains when combined with existing land use/land cover data, rainfall models, and watershed models.

There are other concepts for creating thematic coverage. NIMA will explore sharing the acquisition costs of thematic coverages. Other international and federal government agencies have expressed an interest in cost sharing in geospatial information acquisition

programs. Also, NIMA may contract for transportation networks using commercially available sources but allow the producer to keep commercial rights to the data. This approach could reduce overall production costs to the government while incentivizing commercial imagery companies to become value-added providers. With innovative incentives and a stable contracting schedule, commercial producers could establish a stable workforce and infrastructure that offer greater information availability at reduced cost.

2.4.15 Generating New Content

NIMA will transition to foundation-based operations as rapidly as resources allow, with current targets of initial operational capability (IOC) in Fiscal Year (FY) 03 and full operational capability (FOC) in Fiscal Year (FY) 05. Full operational capability for foundation-based operations is defined as the point in time when NIMA will be acquiring, producing, and managing the digital content required by FD and MSDS in order to produce all output, regardless of media, from this content. The NIMA workforce will continue to improve the information utility of USIGS geospatial information holdings through source collection, acquisition of commodity data, management of coproduction initiatives, contract production, and in-house production (Figure 26).

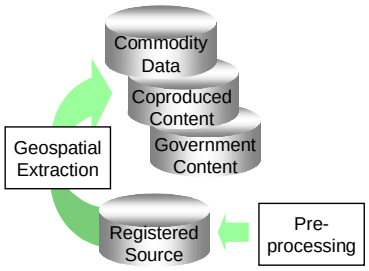


Figure 26 – Generating New Content

NIMA's regional teams will continue to assess existing holdings available to customers against safety of navigation, global, and mission-specific requirements. Where shortfalls exist, they will explore alternative sources of geospatial information. NIMA will develop community partnerships and cost-sharing opportunities for acquiring and maintaining data.

Contract production will focus on required content and not process. NIMA will transition to a strategy of ensuring that quality assurance is built into the process rather than focusing on post-production quality reviews. Again, when possible, NIMA will allow contractors to retain commercial rights to data in order to reduce costs to the government.

Foundation Data

- **Land Components**

NIMA will contract for foundation data production and retain an in-house capability to produce some Foundation Feature Data

The total requirement for land components of FD is 19,200 one-degree cells. This requirement guides production of the controlled imagery and elevation components. Many of these cells are in areas where we have international coproduction partners or which represent minimal risk to national security. NIMA will work closely with its international partners on a shared strategy for near-global coverage with foundation data components. Consequently, NIMA will focus its FFD acquisition and production by 2010 either on areas of the world that present some degree of national security risk or that are not covered by our international coproducers. The focus area is approximately 10,700 one-degree cells. Intelligence and military priorities will guide prioritization of the areas covered by the 10,700 one-degree cells. Acquisition of global

and regional thematic coverages will also reduce the overall cost of FFD. The long-term goal is still to produce near-global coverage (19,200 cells) of seamless feature content.

NIMA will automate many content production steps, particularly far upstream where processes are repetitive

By 2010, the Future Imagery Architecture (FIA) could provide controlled monoscopic and stereo imagery and digital elevation models as by-products of the ground processing system. In pursuit of this capability, NIMA will make near-term investments to validate the algorithms needed for fully autonomous processing. Once proven, these algorithms will migrate to the FIA ground processing segment.

- **Global Safety of Navigation**

Global safety of navigation has stringent requirements and must be managed as an integral part of the geospatial foundation

NIMA's global safety of navigation program, which covers both maritime and flight safety, will continue to respond to ever-increasing requirements for accuracy, density, and currency. For example, the Navy's planned transition to an all-digital bridge will make maintenance of Digital Nautical Chart (DNC) a priority. All Services are increasing their requirements for enhanced vertical obstruction and airfield data. Both maritime and aerial safety of navigation are components of FD, and by extension, are significant elements of the content that NIMA produces now. Further discussion of this data follows.

- **Ensuring Maritime Safety**

USIGS will collect, evaluate, and compile all available worldwide navigation data for dissemination by radio, satellite broadcast, web access, and hardcopy as required. Requirements for digital nautical safety of navigation information continue to grow rapidly due to technology advances in navigation, command and control, and weapons systems. This growth will cause the USIGS to transition from a primarily manual hardcopy environment to a future all-digital environment. This will require maintenance of maritime analytical expertise, rapid insertion of advanced technologies, augmentation of in-house resources with contractor capabilities, a viable coproduction program, and increased emphasis on digital access and dissemination.

The need for maritime analytical expertise will require that NIMA continue recruiting, developing, and sustaining the necessary people. Their expertise supports the transition from being a producer of charts and publications to becoming an information service provider for maritime safety. To deal with anticipated growth in requirements for maritime information, NIMA must become a "smart buyer" of information, products, and services from the commercial sector and maintain its international leadership role in maritime forums.

Advanced technologies (e.g. object-based databases developed in accordance with the UEDM) will support NIMA's efforts to develop an integrated data capture and maintenance environment. Consequently, maritime analysts freed from hardcopy chart production will be able to focus their activities on source collection, assessment, and timely database maintenance.

Maintenance of NIMA's nautical safety of navigation data will remain a priority. NIMA's hydrographic production elements operate using a networked data maintenance environment. NIMA will establish a hydrographic feature database, developed in accordance with the UCDM/UEDM, as part of the integrated air, land, urban, ocean, littoral, and space geospatial framework. This database will optimize processing performance, eliminate redundancy, create known quality and accuracy, and support tailoring of maritime safety of navigation information based on customer needs.

NIMA will make maritime safety information available digitally on physical media (e.g., CD-ROM) as well as through the NIMA portal. Reports and new sources will drive database maintenance. NIMA will broadcast updates immediately by radio and satellite; it will also do a smart push of updates through the web. As customers reach more digital information through Public Key Infrastructure (PKI) technologies, NIMA and DLA can expect reduced demand for printed material.

As part of the ongoing refinement of air, land, urban, ocean, littoral, and space components of the trusted geospatial framework, NIMA will develop new hydrographic MSDS for surface and subsurface navigation. NIMA will also work to integrate terrain data with the hydrographic safety of navigation program's for identification, collection, and maintenance of near-shore (brown-water) and shore features. NIMA will work with the National Oceanic and Atmospheric Administration as a mission partner for near-shore CONUS information. Implementing a common vertical datum for hydrographic and terrain features will correct current deficiencies when integrating maritime and terrain information. This common vertical datum will facilitate an integrated data management environment while maintaining the capability to provide height or depth information in accordance with customer requirements.

Exchange of maritime safety of navigation information will follow both military and open international commercial formats. NIMA will automate production of hardcopy charts and nautical publications, providing a direct digital-to-press feed when required.

- **Ensuring Safety of Flight**

Aeronautical navigation systems have become more sophisticated and require greater coverage, enhanced content, and increased accuracy. The number of sources for the information has grown along with the requirements. NIMA faces significant challenges in helping ensure safety of flight into the future. These challenges include maintaining a world-class aeronautical workforce, rapidly inserting new technologies, developing cooperative coproduction agreements, and facilitating web-based access and dissemination.

NIMA will continue to recruit highly skilled aeronautical analysts. These experts must maintain a viable safety of flight program for the USIGS while sustaining the nation's critical role in international aeronautical programs.

NIMA, in coordination with the military, national, and international aeronautical communities, will develop new MSDS for the air environment using FD components as the base. The FFD and aeronautical safety of navigation programs will identify and report airfield and vertical obstruction data.

Advanced technologies (e.g., object-based databases developed in accordance with the UEDM) will support NIMA's efforts to develop an integrated data capture and maintenance environment. Automated change detection algorithms will allow the USIGS to concentrate its resources on database maintenance rather than on source analysis. NIMA will assign aeronautical analysts to maintenance activities based on the volume and time-sensitivity of change affecting safety of flight that occurs in a given geographic area.

NIMA will host all safety of flight information, at multiple security levels, through its portal. Updates that affect current safety of navigation will be immediately posted online. Database updates pushed forward via the web and satellite broadcast will enhance safety of flight. Changes to international and national navigation rules with future effective dates will also be made available via the NIMA portal as well as via printing and distribution cycles for hardcopy when required.

Customers will gain intelligent access to NIMA's aeronautical content through advanced browser technologies. The amount of printed material distributed will decrease over time as customers gain improved access to more current digital information through such enhancements as PKI technologies. Customers will develop the mission planning, rehearsal, and execution systems needed to integrate aeronautical information into their information operations. Data exchange will follow existing military and open international commercial formats. These technologies will also help customers build a trusted aeronautical view of the mission space, part of the Single Integrated Air Picture (SIAP) and the overall CROP.

Increased requirements for vertical obstruction data (50 feet above ground level in support of mission-specific operations) will encourage development of advanced sources such as radar. The USIGS must direct research and development efforts toward exploitation of such sources. NIMA will collect and attribute point, linear, and aerial obstructions as critical elements of the aeronautical portion of the integrated database. NIMA will then use this digital vertical obstruction data with other terrain and hydrographic information to create integrated views of the mission space based on intended uses of customers.

Mission-Specific Data Sets

NIMA will reprogram its workyears and train its workforce to densify FD into MSDS.

- **Readiness MSDS** is that for which the planned lead time for a mission or an operation will not allow the required MSDS to be generated "just in time."
- **Responsiveness MSDS** is that for which capability and capacity exist to meet customers' timelines.

The IGCRD establishes the volumetric requirement for responsiveness MSDS. NIMA has converted this requirement into a core workforce requirement to satisfy coverage, content, and timeline requirements. NIMA will develop a core workforce capable of surging against a crisis requirement and augment further with contract support. Crisis requirements involving more than one area may require NIMA to shift contract production resources associated with FD to MSDS production.

NIMA must be prepared to work with the intelligence community and operational forces to densify and update existing content. In addition, NIMA will provide the services to assist in analytic and visualization operations when requirements exceed what the technical staff of

organizations and operational forces can handle themselves. NIMA's workforce must be multi-talented and flexible. Although normally focused on populating and maintaining geospatial information holdings for the USIGS, NIMA's geospatial analysts must be able to exploit those holdings to support customers, tailor content for specific missions, and perform situational analyses as well.

2.4.16 Precision Targeting

The US has continually adapted its firepower to situations, environments, and threats to ensure that fights will be unfair in its favor. Our adversaries react to this by keeping high-value targets far from our forces, hardening or hiding them, reducing vulnerability of exposed or close targets by moving them often, or by "hugging" facilities they know we will be reluctant to damage. Increasingly, the solutions to these countermeasures require precision fires, which depend heavily on precision targeting[10] and, in turn, on accurate geospatial information.

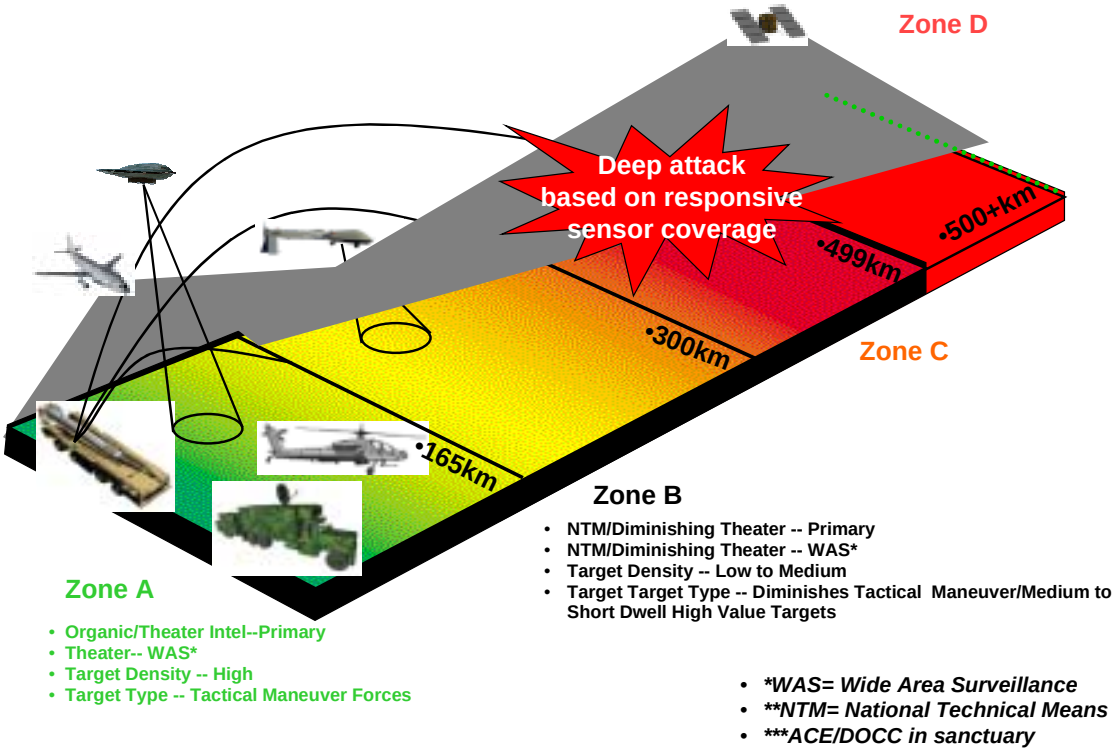


Figure 27 – The Targeting Challenge

The targeting challenge for 2010 will be complex. Advances in telecommunications already permit effective command and control and intelligence operations from hundreds of kilometers away from the fight. High-value targets in the operational deep zone, 300 to 500 kilometers and beyond from the forward line of troops (FLOT), will likely be fixed

[10] Precision targeting is the acquisition of a high pay-off target located with sufficient accuracy to enable attack with the proper asset, lethal or non-lethal, at the precise time resulting in the desired effects.

(immobile) but will increasingly be buried and at a minimum heavily camouflaged or concealed. In the tactical deep zone, high-value targets will be both fixed and fleeting, with strong air defenses around fixed targets and considerable attention to concealment and camouflage for mobile targets like theater ballistic missile (TBM) launchers, surface to air missile (SAM) launchers, and mobile command centers. The close fight zone, out to about 12 kilometers from the FLOT, will have predominantly fleeting targets.

Fixed targets on the surface, regardless of range, are now and will remain vulnerable. What we can see we can hit, if it doesn't move, with coordinate-driven Global Positioning System (GPS) and inertial navigation systems (INS) guided weapons. Weaponeering for buried targets will remain a challenge. Direct-fire systems are getting increasingly effective against all targets in the close fight zone, and the main challenge will be situational awareness and other means to clearly differentiate enemy from friendly forces and noncombatants.

Time-critical targets[11] at deep engagement ranges will remain tough problems in the 2010 timeframe. These targets present short windows of vulnerability as they move, short windows of attack opportunity because of environmental conditions, or both. DoD is striving to shorten timelines in the weapon engagement cycle, illustrated in Figure 28, while holding or improving accuracy.

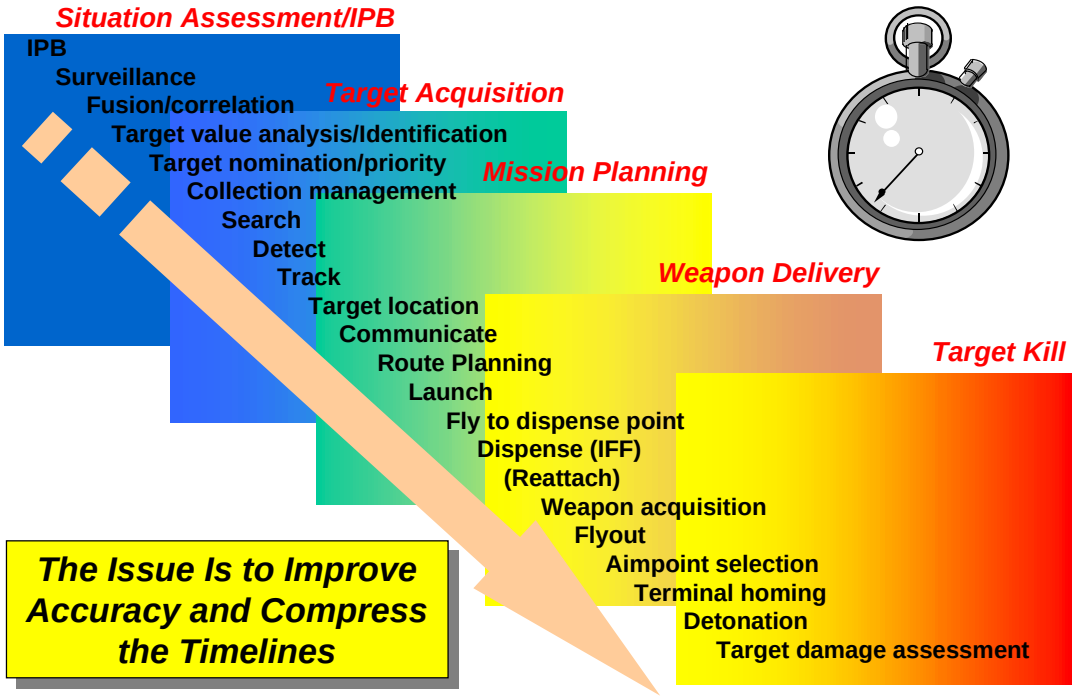


Figure 28 –Steps Affecting Time-Critical-Targeting

Initiatives to improve the targeting cycle that have geospatial implications include:

[11] Time-critical targets are targets that are both a priority and perishable, and should ideally be engaged within minutes of identification; Air Combat Command currently has a goal to commit weapons on a declared time-critical target in 10 minutes or less.

- Reduce search areas for mobile targets through Intelligence Preparation of the Battlefield (IPB), including terrain analysis that assists in delimiting possible employment areas
- Overlay intelligence, surveillance, and reconnaissance (ISR) assets to watch probable areas, performing autonomous geometric correction of sensor data to enable on-the-fly change detection
- Overlay weapons coverage patterns, adjusted for holidays in line of sight or weapons trajectories due to terrain, to assist in rapid selection of the right weapons
- Streamline any required dynamic targeting support around finding / fixing / tracking / targeting / engaging /assessing (F2T2EA); examples of streamlining include:
- registering take from the Joint Surveillance Target Attack Radar System (JSTARS) Moving Target Indicator (MTI) to national technical means (NTM) imagery through the JSTARS Imagery Geolocation Improvement (JIGI),
- the Common Geospatial Processing Capability (CGCP) Advanced Concept Technology Demonstration (ACTD) that is striving to get precision-guided munitions (PGM) accuracies from tactical imagery in 60 seconds,
- the Enhanced Precise Positioning Integrated Capability (EPPIC) of the Air Force, and
- a variety of efforts to break out of stovepipes of ISR sensor feeds and processing through internetted, mutually cued sensors with links to shooters and integration across platforms and echelons.

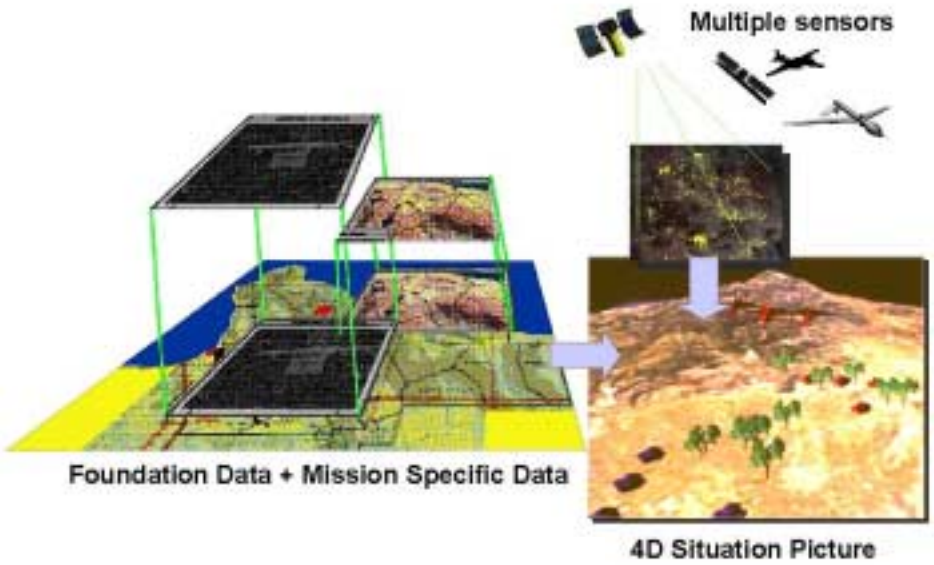


Figure 29 – Fusion to Support Time-Critical Targeting

The solutions for time-critical targeting are essentially the same as for effective command and control generally – fused content, dynamically maintained through heavily automated processes, that provides alerts on developing situations and is readily accessible as coherent pictures for all involved decision makers.

The primary payoff of improvements in precision targeting will be the ability to use smaller munitions to create the same effect. This translates into more weapons per launch platform, more targets at risk per sortie, therefore fewer sorties, and ultimately into reduced risk to launch platforms and crews as well as lower cost. Precision targeting will also yield more controlled weapons effects, resulting in some reduction in collateral damage.

2.4.17 Obtaining New Source

Given a requirement for MSDS or other unique geospatial information need, NIMA's regional team will work with the USIGS to assess availability of existing data sources. Should existing data sources not be available, then the availability of adequate source material will be assessed. When available source material is inadequate, NIMA will task national and commercial collection systems or request that other members of the USIGS provide source that could yield information over the area of interest to meet the intended use (Figure 30). For instance, NIMA will have access via virtual networks to operational and tactical resources that could generate the timely high-resolution data needed to support such functions as battle damage assessment.

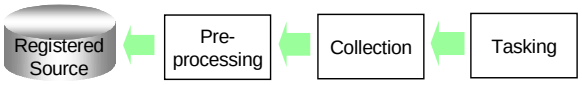


Figure 30 – Obtaining New Source

Source material will include softcopy imagery as well as hardcopy collections. In addition, regional experts will do data mining to seek and assess additional source material that might be available via the web or elsewhere in USIGS.

When adequate source is available (either ready to use or specifically tasked), NIMA staff will decide whether to do the work in-house, by coproducers, by contract, or via data acquisition. They will assign work using internal production management tools. Customers, NIMA personnel, coproducers, and contractors will have on-line access to production status information as well as to sources needed to support a specific requirement. Producers can download digital source data at various security classifications from USIGS libraries. The NIMA Library will assess and assemble hardcopy materials.

Advanced collection planning tools will aid tasking for the many available collection systems

2.4.18 Designing and Fielding New Collectors and Ground Architectures

The deepest reach-back envisioned for the geospatial customer or producer is into the need for a totally new collection capability. Sensors evolve in response to both technological opportunity and new requirements. The elapsed time to design, test, and deploy both the imaging system and the

Going after a totally new kind of collector represents the deepest and most time-consuming form of reach-back

associated ground architecture means that requirements must be established well in advance. Other procedural or collection system changes will similarly require long lead times. NIMA and its mission partners will work together to ensure the ever-increasing requirements for accurate, relevant, and timely geospatial information are considered throughout this process.

2.5 Integrating Advanced Technologies

Several key trends will continue to impact achievement of this Geospatial Concept of Operations for 2010. First, the rapid rate of change in information technologies limits our ability to accurately predict the future. Rapid advances in storage, processing, and communications technologies will continue to outpace our ability to integrate them into our architectures and operations. The intersection of new national and commercial sensors, information technologies, and a maturing geospatial information industrial base will deliver new capabilities that will revolutionize location-based information services. However, these new capabilities will be available to all – friend or foe.

Consequently, in order for government to maintain an edge, we must be able to rapidly integrate standards-based, commercial off-the-shelf (SCOTS)-based technologies using spiral development acquisition methodologies. In addition, the USIGS must sponsor research and development that provides unique capabilities not otherwise available through industry. Such research and development will need to be coordinated across organizations to limit duplication and maximize investment dollars to achieve critical mass. NIMA, as the USIGS Functional Manager, will provide leadership for this coordination activity. Critical areas of focus needed to support this concept of operations are:

Database Design (to support a one-touch shared maintenance environment)

- One primary geometry for objects using one extended conceptual data model
- Multi-dimensional data models to support integration and application of geospatial information to other domains (multi-INTs, operations and logistics, Defense/State/other user communities)
- Minimally-redundant object-based databasing on a global scale
- Logically integrated but physically distributed database with the associated population and maintenance executed by multiple organizations
- Variable (not multiple) representation models; develop trusted generalization algorithms that represent high density data using small scale views
- Capture, management, and dissemination of measures of quality (accuracy, content, completeness, lineage, etc.) using automated metadata generation and error management routines
- Synchronization approaches for distributed data holdings and architectures

Database Population Strategies

- Effective, efficient, and economic densification of foundation data in response to mission-specific requirements
- Assessment and integration of commodity and value-added data
- Development of automated vector/raster, raster/vector data conversion services

- Development of automated data conflation, integration, and registration techniques
- Development of unique feature identifiers
- Development of semi-autonomous and autonomous feature extraction and attribution using new and varied sources (electro-optical, radar, LIDAR, multispectral, hyperspectral, etc.)

Data Maintenance Approaches

- Development of Internet-based change notification capabilities to take advantage of customers empowered with GPS and other "locationally-aware" technologies
- Development of practical collection and maintenance strategies that recognize authorized data ownership
- Ability to dramatically shorten support cycles for precision targeting and other time-critical operations
- Ability to understand how to employ emerging remote and on-the-ground sensor technologies such as automated change detection
- Development of the means for updating and managing temporal geospatial information
- Development of methods to improve the resolution and accuracy of feature representations to include improved ground control, high-resolution terrain information, radar and other sensor exploitation for vertical obstruction data, and dynamic site model generation
- Development of self-healing databases (e.g. Real-time Automated Geo-registration for Exploitation (RAGE) tapeworm) based on the continuous refinement of data accuracies
- Development of new techniques for detecting change to include autonomous geopositioning and orthorectification of imagery source, getting imagery into spatially correct 3-D geometry without degrading resolution, image-to-image change detection, and image-to-feature change detection
- Tasking and management based on change detection

View Generation

- Human factors engineering for spatial data visualization
- Effective means of representing information uncertainty
- User-defined view generation options using standard interface controls, including variable footprint, time-slice, resolution, reference system, feature/theme content, and representation models
- Automated map finishing techniques for generalization, symbolization (including color scheming), name placement, overlay and transparency levels, and marginalia
- Automated viewing capability using content specifications with dynamic database search and retrieval capabilities

- Use of pre-defined viewing templates to include on-the-fly generation of perspective scenes, predicted sensor views (for terminal guidance and for auto-correlation and autonomous navigation in hostile environments) and automated capture of other high-usage view “recipes”
- Exploration of new format and media options, including those that support print-on-demand
- Field generation of hardcopy (durable, waterproof, non-fade) from digits

Accessibility

- Assessing the technical, operational, and cost impacts of data access licensing arrangements proposed by the private sector for commodity data
- Development of the interactive data access methods that comply with open geographic information technology and processing standards, other Internet standards, and security or distribution constraints to include advanced browsers and portal technologies, e-business models, and trusted multi-level security.

2.6 The Total Flow in Context

The USIGS Geospatial CONOPS 2010:

- has NIMA in a central role as an information service provider and broker of information that it creates, acquires, or identifies,
- pushes geospatial information and services forward to enhance decision making,
- places a premium on timeliness, accuracy, known quality, and completeness of geospatial information,
- recognizes the need for a world-class information-based workforce,
- provides greater geospatial capabilities for policy makers and warfighters,
- establishes a data-centric business model for the producer community, in which the architecture is built around databases that integrate geospatial information and images as well as other relevant intelligence data, making these databases independent of location and client, and permitting update from authoritative providers,
- moves the user community from legacy products to an integrated geospatial framework from which downstream customers can construct the products—legacy and new—that they need; standard products become scripted views of the database, and
- implements an e-business enterprise that allows online order taking and order fulfillment as well as peer-to-peer and business-to-business transactions.

Figure 31 illustrates the total flow of geospatial support against a backdrop showing how it fits in the overall cognitive hierarchy, getting the right kind of content to the right kind of decision makers and operators at the right time.

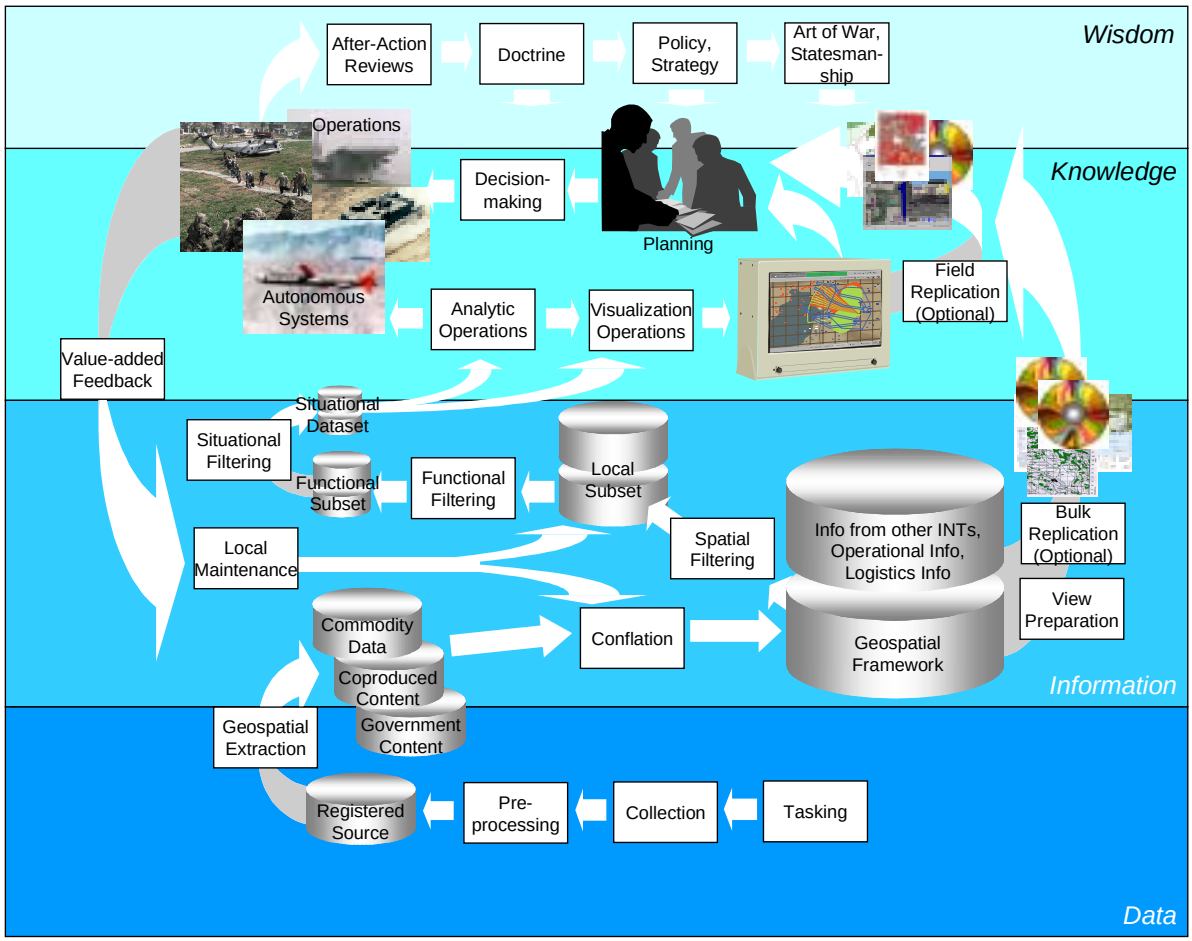


Figure 31 – The Flow of Geospatial Support

United States Imagery and Geospatial Information Service (USIGS)

USIGS Geospatial Implementation Master Plan

AUGUST 2001

II. USIGS Geospatial Implementation Master Plan

1 Introduction

The USIGS Geospatial Concept of Operations for 2010 (CONOPS 2010) describes the desired end-state for geospatial information acquisition, processing, exploitation, and dissemination. It serves as a guide for NIMA's transition to foundation-based operations and for delivery of the digital infrastructure for the USIGS geospatial domain.

This implementation master plan provides the FY03-07 roadmap for the path to the USIGS Geospatial CONOPS 2010 vision. It identifies funded initiatives in NIMA's current program plus the additional partially funded and unfunded initiatives needed to advance toward the objective geospatial capability. Under this plan, NIMA will accelerate the transition from today's mix of legacy production and foundation data production to full foundation-based operations. The goal is to achieve foundation-based operations by the end of FY05. NIMA will work with its customers to terminate products from legacy stovepipe production systems and, as required, provide geospatial information, products, and services derived from foundation-based operations.

The relationship of NIMA's current program to the partially funded and unfunded geospatial implementation initiatives described in this plan is shown in Figure 1.1.

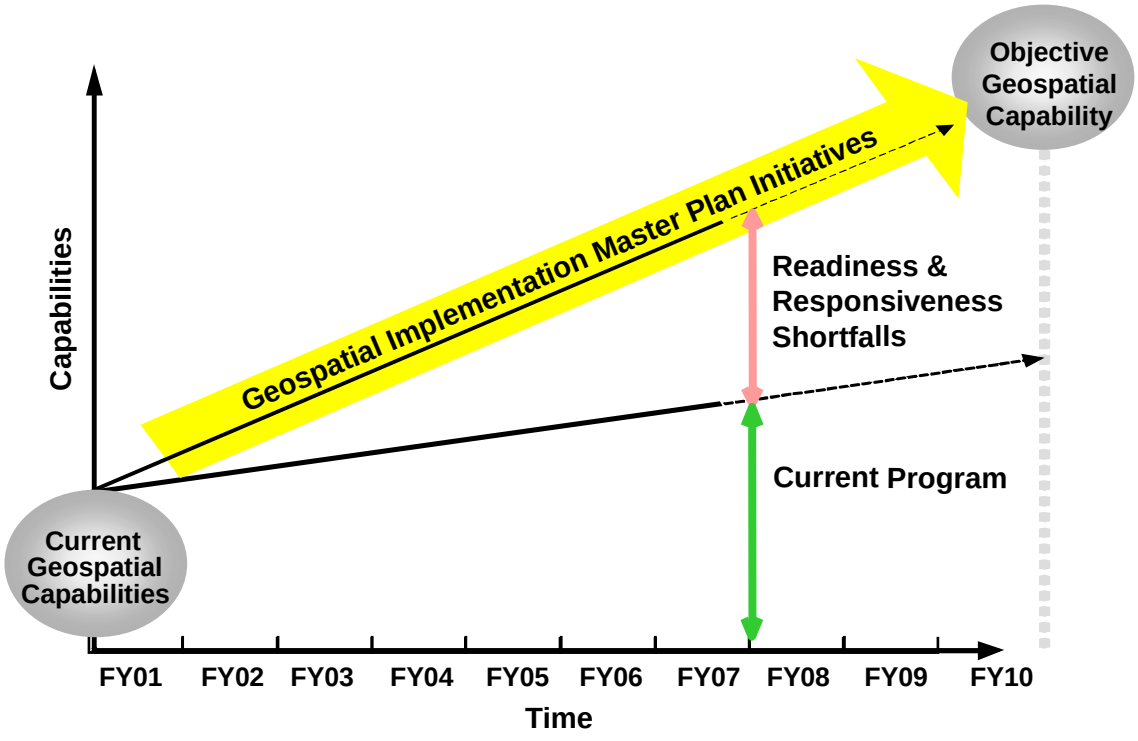


Figure 1.1 Relationship of NIMA's Current Program to the Additional Initiatives Required to Achieve USIGS Geospatial CONOPS 2010 Capabilities

Implementation of this master plan will enable the Services, Defense Community, and Intelligence Community to transition away from non-interoperable geospatial information

provided by NIMA's legacy stovepipe production of the past. It describes a program that builds on community collaboration, leverages new and alternative sources of information, addresses re-engineering of critical business processes, and strives for continuous insertion of standards-based commercial technologies to build a near-global foundation of geospatial information and the capability to rapidly intensify that foundation. The ultimate goal of this plan is to deliver geospatial information that is accurate, timely, and relevant to USIGS customers' operational and mission requirements.

Five primary thrusts are developed throughout the plan – they support achievement of the goals articulated in the NIMA Strategic Plan:

- Provide intelligent access to community digital geospatial information holdings,
- Generate a seamless integrated framework of trusted geospatial information,
- Exploit new sources, including acquisition of commodity data,
- Provide analysis to exploit geospatial content, and
- Develop an integrated imagery, imagery intelligence, and geospatial information digital infrastructure.

2 Roadmap for USIGS Geospatial Implementation

A roadmap for the geospatial implementation initiatives is presented in Appendix E of the GTP. The roadmap may be used in conjunction with this master plan to provide an overview as the following topics in the master plan are addressed:

- Ensuring Success,
- Requirements Management,
- Standards Selection/Development and Implementation,
- Information Management,
- Information Acquisition and Production,
- Exploitation Capabilities,
- Information Access, Discovery, and Retrieval,
- End-User Tools and Services, and
- Education and Training.

Section numbers in the master plan correspond to the initiative numbers in the roadmap. Appendix E may either be manually separated from this bound document or it may be printed from the CD-ROM enclosed with the GTP to provide a companion document.

Both the master plan and the roadmap indicate whether an initiative is funded, partially funded, or unfunded through NIMA's current program. Time phasing is represented as near-term (FY01-03), mid-term (FY04-05), and long-term (FY06-07). In the roadmap, an arrow is used to show where additional funding is required over an indicated period. Specific funding profile information is available in a separate, classified annex to the GTP. This annex is available by accessing the NIMA Analysis and Plans (AP) Publications and Documents page located on the:

- SIPRNET at http://www.nima.smil.mil/projects/ap/docs.html
- JWICS at http://server1.westfield.nima.ic.gov/ap/docs.html

Funded and partially funded initiatives form the basis for development of planning and programming guidance to USIGS. These funded and partially funded initiatives are provided separately as the "Geospatial Input to the 2001 USIGS Functional Manager's Guidance FY04-09;" see Appendix A. When issued, the USIGS Functional Manager's Guidance will provide direction relevant to planning and programming for NIMA and other USIGS organizations.

Although the basic building blocks of the plan are either fully or partially funded, it is also important to the future planning activities of USIGS organizations to understand what remains to be funded. Senior leadership within the Intelligence and Defense communities will address these shortfalls as part of the overall strategic planning, programming, and budgeting process. The sections that follow present the total set of initiatives required to execute the implementation master plan.

3 Ensuring Success

3.1 Develop a Supportive Policy and Resource Environment

Funded **OPR: NIMA PCO**

Implementing the geospatial domain of USIGS depends on development and sustainment of a supportive policy and resource environment. Through communication and coordination efforts with customers, NIMA will continue to convey the:

- Potential application and value of geospatial information
- Impact of shifting to foundation-based operations
- Importance of developing the trusted geospatial framework to support the Common Relevant Operational Picture (CROP)
- Inability of legacy standard product production systems, processes and procedures to support the CROP

3.2 Build Alliances with National and International Partners

Funded **OPR: NIMA PCO**

Availability and compatibility of geospatial information from national and international partners will play a very important role in achieving NIMA's readiness and responsiveness strategy. NIMA will foster partnerships through promotion of USIGS concepts and work toward adoption of open standards that support sharing and interoperability of geospatial information.

3.3 Build Alliances with Industry

Funded **OPR: NIMA DO/AT**

The reliance NIMA will place on the commercial sector is an integral element of the master plan. NIMA will actively seek to procure commodity geospatial information, production services, and production support. To support these activities, NIMA will ensure

establishment of consistent and stable contract programs and partnership mechanisms that incentivize efficiency and quality assurance.

3.4 Facilitate Sharing of Imagery and Geospatial Information

Funded **OPR: NIMA NP/CIO**

NIMA will work with the Assistant Secretary of Defense for Command, Control, Communications and Intelligence (ASD(C3I)) and with the DoD Chief Information Officer (CIO) to review disclosure/release policies and procedures. ASD(C3I) and DoD CIO will be leading efforts to develop solutions and make appropriate changes that will facilitate sharing of imagery and geospatial information.

3.5 Establish Measures of Success

3.5.1 Improve Customer Satisfaction

Funded **OPR: NIMA PCO/CIO**

NIMA will assess existing performance measures established to quantify customer satisfaction. As required, new metrics will be established to measure NIMA's performance in providing tailored geospatial information. For example, performance measures must reflect the work done by NIMA's technical representatives, liaison officers, and the specialized support provided by NIMA's in-house geospatial workforce. Performance measures must assess and quantify the contribution these NIMA programs make to geospatial readiness.

3.5.2 Quantify Geospatial Information Utility

Partially Funded **OPR: NIMA PCO**

To support transition from product-based requirements to information-based requirements, NIMA will develop and implement new processes and metrics to measure the effectiveness of foundation-based operations. Effectiveness must be assessed in terms of NIMA's ability to support USIGS geospatial readiness requirements.

Currently, NIMA uses an "adequacy" evaluation that categorizes into three broad classes the ability of a map, chart, or digital product to satisfy USIGS requirements. Products are rated as "adequate," "limited use," or "no coverage" based on their assessed ability to meet all intended uses. A "limited use" or "no coverage" rating may trigger action to update a specific product or build a new one even if an available product is capable of satisfying some or most intended uses.

NIMA will acquire increased amounts of geospatial information from alternative sources to accelerate population of the global database. Acquisition of thematic coverages is a more cost-effective way of achieving global and regional coverage, and NIMA will adapt its product evaluation process to facilitate this new database population strategy. This type of information – for example, a road network – would likely receive a rating of "limited use" under the present evaluation system since it does not satisfy the minimum information requirements of a standard data set such as FFD.

With foundation-based operations, NIMA will implement an evaluation process that quantifies the "utility" of available geospatial information in satisfying specific intended uses and assigns numerical scores. A metric for information "utility" will be established that

considers factors such as coverage, density, accuracy, and age relative to a specific intended use. Numerical scores can be weighted for certain intended uses (e.g., age may be weighted more than accuracy for a specific intended use). Additional funding is required to fully implement this approach to quantifying information utility.

The utility-based approach promotes exploitation of alternative sources of geospatial information. For example, if FD or MSDS cannot be generated in time to meet a mission requirement, a decision may be made to buy an existing commercial product that provides a critical degree of "utility" but does not fully satisfy all intended uses.

3.5.3 Global Readiness

Funded **OPR: NIMA PCO**

NIMA will develop a measure of global readiness based on the "utility" provided by components of foundation data. Although individual organizations within USIGS have begun to specify requirements for components of foundation data, no overall agreement has been reached as to the contribution of these components to readiness. Ongoing collaboration within USIGS is required to determine the standards that will be used to assess global readiness.

3.5.4 Safety of Navigation

Funded **OPR: NIMA PCO**

As required, NIMA will review and update the metrics used to measure accuracy and currency of aeronautical and maritime safety of navigation information. As NIMA moves to implement the integrated information environment for geospatial information, NIMA customers will benefit from more timely updates that will be available when maintenance is performed continuously to refresh content in the trusted geospatial framework.

3.5.5 Mission Readiness

Funded **OPR: NIMA PCO**

NIMA will continue to evaluate mission readiness in accordance with Joint Staff policy and the Joint Monthly Readiness Review (JMRR) process. However, under foundation-based operations, mission readiness will focus on foundation data as the primary component of readiness in conjunction with NIMA's capacity and capability (e.g., availability of source material) to generate MSDS in response to the lead times of the mission. For planned or anticipated operations where mission lead times are too short for NIMA to respond and produce the required MSDS in time, MSDS will be scheduled for generation in advance.

3.5.6 USIGS Performance

Funded **OPR: NIMA CIO/AT/IS**

NIMA's acquisition and technology program seeks to constantly improve the capabilities and performance of the USIGS. NIMA will develop and track critical capability and performance measures that impact the overall efficiency and effectiveness of operations. For example, production times, throughput rates, and dissemination times must be tracked to assess and report on improvements related to process reengineering or the introduction of new capabilities. At the same time, performance measures must also ensure the accuracy and utility of information provided.

3.5.7 Transition to Open Standards

Partially Funded **OPR: NIMA DO/AT**

NIMA will establish a plan and metrics for achieving interoperability through transition to open standards. The plan will specifically address implementation of proven standards-based commercial off-the-shelf (SCOTS) applications and services and open standards for interfaces and geospatial information exchange. Metrics will be identified for quantifying potential improvements in NIMA's ability to acquire, manage, and disseminate interoperable geospatial information.

NIMA will participate and invest in industry-based interoperability programs to introduce USIGS requirements. Through these industry activities, leading technology companies may be influenced to cooperate in establishing interface specifications that are key to development and fielding of SCOTS-based solutions that meet specific USIGS needs.

By influencing and leveraging evolving open standards, NIMA will be able to move from the near-term file-based information management environment toward the object-based environment of the NIMA Integrated Information Library (NIIL).

3.5.8 Reduce the Cost of Foundation-Based Operations through Information Acquisition

Partially Funded **OPR: NIMA DO/AT/IS**

NIMA will continue to transition to foundation-based operations by acquiring and taking maximum advantage of imagery and geospatial information available through:

- Other government sources,
- International sources,
- Trade, barter, or cooperative collection/production agreements, and
- Commercial purchase.

NIMA will establish processes and metrics for the acquisition, integration, production, and maintenance of foundation data and MSDS that exploits a wide variety of sources. Source quality, accuracy, and utility in meeting requirements will be evaluated. Metrics will be used to refine projected internal production resource estimates and outsourcing costs required to meet the geospatial information needs expressed in the Imagery and Geospatial Capstone Requirements Document (IGCRD).

3.5.9 Leverage e-Business Solutions to Improve Customer Access

Partially Funded **OPR: NIMA AT/IS**

The explosion of e-business activity in the commercial sector presents an opportunity for NIMA to increase access and reduce dissemination costs for imagery, imagery intelligence, and geospatial information. NIMA will leverage proven e-business practices and begin implementing web-based services. For example, NIMA will provide selected access to information through portal services such as *earth-info* (www.earth-info.org) and the Intelligence Community Geography Network (IC GeoNet). These and other pilot projects will be used to establish metrics and evaluate performance improvements achievable through technology insertion.

3.5.10 Participate in Scheduled USIGS Exercises, Experiments, and Demonstrations

Funded	OPR: NIMA PCO/DO

Essential elements of the USIGS Geospatial CONOPS 2010 will be assessed through NIMA's routine participation in scheduled exercises, experiments, and demonstrations. As part of the marketing plan for foundation-based operations, NIMA will demonstrate the "readiness and responsiveness" strategy in Service and CINC exercises. Through this participation, NIMA will collect metrics, develop lessons learned, and plot course corrections to the USIGS Geospatial Implementation Master Plan.

Along with participation in exercises, experiments, and demonstrations, NIMA will look for opportunities to involve collaborative industry pilot programs and demonstrations. This will provide commercial vendors with the most direct opportunities to understand and respond to USIGS requirements through enhanced SCOTS capabilities.

4 Requirements Management

4.1 Transition to Information-Based Requirements

4.1.1 Implement an Information-Based Requirements Process

Funded	OPR: NIMA PCO

Through application of intended-use codes in the current Requirements Analysis System (RAS), NIMA will begin to accept and manage information-based requirements vice product requirements. To implement this capability, specific intended uses will be mapped to the information components that comprise foundation data and MSDS. NIMA customers will still use existing standard index bases to identify area coverage requirements.

To support implementation of information-based requirements, NIMA is coordinating with the Services and Agencies to complete development of specifications that define data content for mission-specific data sets.

4.1.2 Rebaseline the Geospatial Requirements Deck for Foundation-Based Operations

Funded	OPR: NIMA PCO

NIMA will lead an effort to fully implement foundation-based operations and the associated "readiness and responsiveness" strategy. NIMA will schedule visits to each major customer to explain the strategy and provide support in the rebaselining process to focus on intended uses and their translation into information requirements (e.g., components of FD and MSDS).

NIMA will plan to terminate traditional products produced from legacy stovepipe production systems and work with customers to provide replacement geospatial products and information to meet operational requirements.

NIMA will continue to support the digital data content and exchange formats for existing systems. Longer-term, NIMA will work with customers to migrate these systems to use information derived from the shared geospatial framework and open standards for interfaces and geospatial information exchange.

Under the concept of foundation-based operations, foundation data will be used as the basis for MSDS. Over the near- and mid-terms (FY01-05), NIMA will focus its geospatial information acquisition and production program on foundation data and produce MSDS in response to immediate operational and training needs.

4.1.3 Link Requirements to Production Management through the Production Management Alternative Architecture

Funded **OPR: NIMA DO/AT**

Through development of the Production Management Alternative Architecture (PMAA), NIMA will link foundation data and MSDS requirements documented in RAS with production management capabilities. This will provide NIMA with the tools to track program status and better allocate resources for foundation-based operations.

PMAA is being implemented as a series of pilot programs. Pilots 1 through 3 are funded under the current program, and the linkage to RAS will take place as part of the Pilot 3 program.

4.1.4 Provide Online Customer Access and Manage Requirements for Tailored Information

Unfunded **OPR: NIMA PCO/IS**

As a mid-term (FY04-05) step toward achieving a fully integrated requirements management capability, NIMA plans to implement enhancements to PMAA/RAS. These enhancements, although currently unfunded, will enable customers to submit requirements for geospatial information and receive status online using the NIMA Gateway web-based interface.

NIMA will also modify PMAA/RAS to accept and manage requirements for tailored information – these are information needs that do not match the content in the standard components associated with foundation data or MSDS. An example is a customer requirement for power lines and power stations for a critical-node analysis of the power grid in a specific area of interest.

Many of the requirements addressed by NIMA technical representatives and liaison officers are for highly tailored information that can only be described in a “free text” form. An example is a recent requirement to support a mission covering islands in the Aegean Sea. Current and historical authoritative information was provided from a variety of sources on shoreline delineation and geographic names. To capture these highly tailored needs, NIMA will enhance PMAA/RAS to accept and manage requirements stated in “free text” form.

4.1.5 Develop an Integrated Information Requirements Management Capability

Partially Funded **OPR: NIMA PCO/AT**

Longer-term, NIMA will work with other imagery and information providers in the USIGS to develop and field an integrated information requirements management capability. This future system will address USIGS integrated requirements and production management capabilities for all of NIMA’s mission areas: imagery, imagery intelligence, and geospatial information. It will be designed around a shared requirements database (SRDB), and the system will provide order entry and tracking and workflow management capabilities.

The system will provide USIGS with an online interface that enables an enterprise view of requirements management. This view will show NIMA customers the status of submitted requirements as they are tracked through all phases of information development and delivery to the ultimate user (i.e., through requirements, tasking, collection, acquisition and production management, workflow, ordering, dissemination, and user satisfaction).

NIMA's participation in the SRDB is funded under the current program. Additional funding is required to implement the system.

4.2 Assess and Optimize Support to Geospatial Readiness

4.2.1 Conduct Timely Information-Based Readiness Reviews

Funded **OPR: NIMA PCO**

NIMA will meet formally with the Joint Staff and authorized submitters of geospatial requirements on a quarterly basis to review approximately one-fourth of the supported OPLANs, CONPLANs, and initiatives. To meet dynamically changing requirements, NIMA will constantly collaborate with authorized submitters from the CINCs, Services, and Agencies (C/S/As). The goal of this constant collaboration is to assess and redirect ongoing imagery and geospatial information acquisition and production programs. NIMA will work to:

- Provide expertise in the use and application of NIMA's geospatial information holdings,
- Assess holdings in meeting specific geospatial readiness requirements,
- Capture and prioritize new USIGS geospatial information needs,
- Build "coalitions" for specific acquisition/production requirements,
- Seek out new and timely alternative sources to speed acquisition/production,
- Explore cost-sharing opportunities for commercial data that may satisfy otherwise unfulfilled needs, and
- Eliminate requirements no longer deemed necessary.

4.2.2 Allocate Production Resources to Optimize Geospatial Readiness

Funded **OPR: NIMA PCO/DO**

To implement foundation-based operations, NIMA resources for geospatial information will be allocated through an iterative process across three key mission areas:

- Safety of navigation,
- Global readiness, and
- Mission-specific support.

Resources for safety of navigation will continuously address the global mission for aeronautical and marine safety. NIMA will maintain a level of effort for safety of navigation to ensure timeliness and currency of this critical information.

For global readiness and mission-specific support, resources will be allocated regionally based on the readiness review process conducted with authorized submitters from the C/S/As.

Traditionally, NIMA has allocated map, chart, and digital production resources to satisfy specific sheet-by-sheet or cell-by-cell coverage requirements to support specific OPLANs/CONPLANs. NIMA will work with submitters to translate these product-based requirements into information requirements based on intended use and prioritized by region.

This resource allocation approach will enable NIMA to improve geospatial readiness through acquisition of information from alternative sources and focused production that accelerate population of the shared geospatial framework based on:

- Source data available in a regional area – in terms of total area coverage and thematic data layers, and
- Utility of the resulting geospatial information integrated into the shared geospatial framework – in terms of the resulting improvement in readiness.

5 Standards Selection/Development and Implementation

5.1 Interoperability

5.1.1 USIGS Conceptual Data Model for Geospatial Information

Funded	**OPR: NIMA DO/AT**

NIMA will continue development of the USIGS Conceptual Data Model (UCDM) for geospatial information. The UCDM is key to achieving interoperability for the shared geospatial framework. It creates a uniform set of agreed-upon data definitions and relationships that support development of uniform processes and procedures for collection, coding, conflation, storage, management, and exchange of geospatial information.

The UCDM supports development of standardized metadata that describes the content of the shared geospatial framework. This is essential to building a global catalog for the information held in NIMA's geospatial libraries. It also provides the basis for future exchange of USIGS geospatial information across the web through development of Geography Markup Language (GML) registries and corresponding web-based schemas.

The Geospatial Standards Management Committee/Imagery Standards Management Committee (GSMC/ISMC) provides oversight for the UCDM, since its development and implementation must be coordinated with national, international, and commercial standards bodies.

5.1.2 USIGS Enterprise Data Model for the Integration of Imagery, Imagery Intelligence, and Geospatial Information

Partially Funded	**OPR: NIMA DO/AT**

Through the current program, NIMA will enhance the UCDM beyond geospatial information to develop the USIGS Enterprise Data Model (UEDM), which addresses the integration of imagery and imagery intelligence. The UEDM will provide the framework for the object-based environment planned in the NIMA Integrated Information Library (NIIL).

Industry is moving rapidly to develop web-based solutions for geospatial information interoperability, and UEDM development will enable USIGS to participate in that evolution. Leveraging commercial capabilities through coordination with ongoing national,

international, and commercial open standards activities will facilitate improvements in interoperability across USIGS. As shown in Figure 5.1, by the 2010 timeframe, the UEDM will support USIGS for the imagery, imagery intelligence, and geospatial information foundation of the CROP.

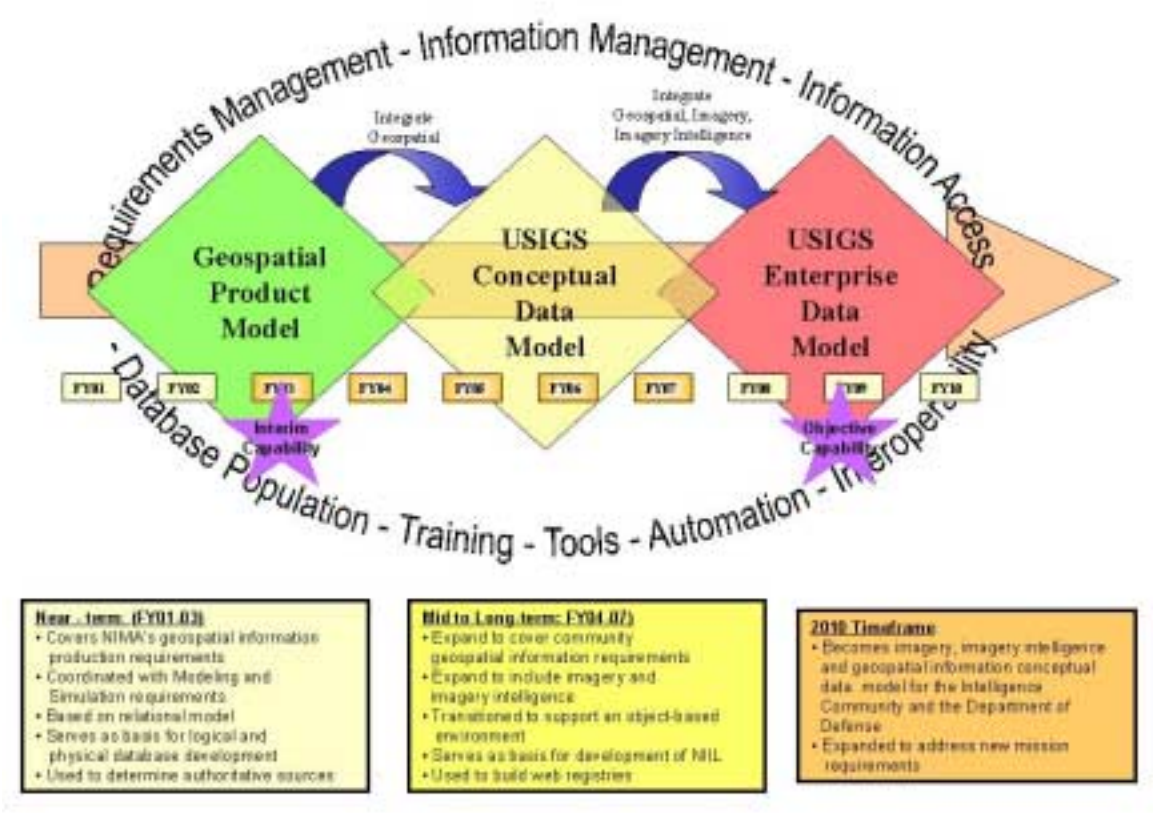


Figure 5.1 Development of the USIGS Enterprise Data Model

With additional funding, NIMA will implement a data model repository that supports access by internal and external developers. NIMA will also manage the USIGS data architecture to support development of logical and physical data model implementations as shown in Figure 5.2.

5.1.3 Imagery and Geospatial Information Exchange Standards

Partially Funded **OPR: NIMA DO/IS**

Development of open exchange standards is partially supported by the current program, but additional funding will be required.

Efforts of the international, national, and commercial communities are playing a key role in the development of open standards for the Internet, web applications, and web-enabled geospatial information – fostering interoperability. NIMA will take advantage of these developments and work to migrate to open industry standards for exchange of imagery and geospatial information.

For vector geospatial information, migration to open standards will take place in two phases. In the first phase, NIMA will establish a Vector Data General Standard. The Vector Data General Standard is based on a consistent set of feature and attribute definitions from the Feature Attribute Coding Catalog (FACC) – called the "NIMA Profile of FACC." The NIMA Profile of FACC is also mapped to the current UCDM. This will enable standardization of feature and attribute coding across topographic, hydrographic, and aeronautical information environments to support interoperability.

In the second phase, NIMA will develop Data Content Specifications for required geospatial information data sets based on the Vector Data General Standard. Data Content Specifications (DCSs) are independent of the required exchange format. They provide the basis for delivering geospatial information in Vector Product Format (VPF), COTS formats, and future SCOTS and web-based exchange formats.

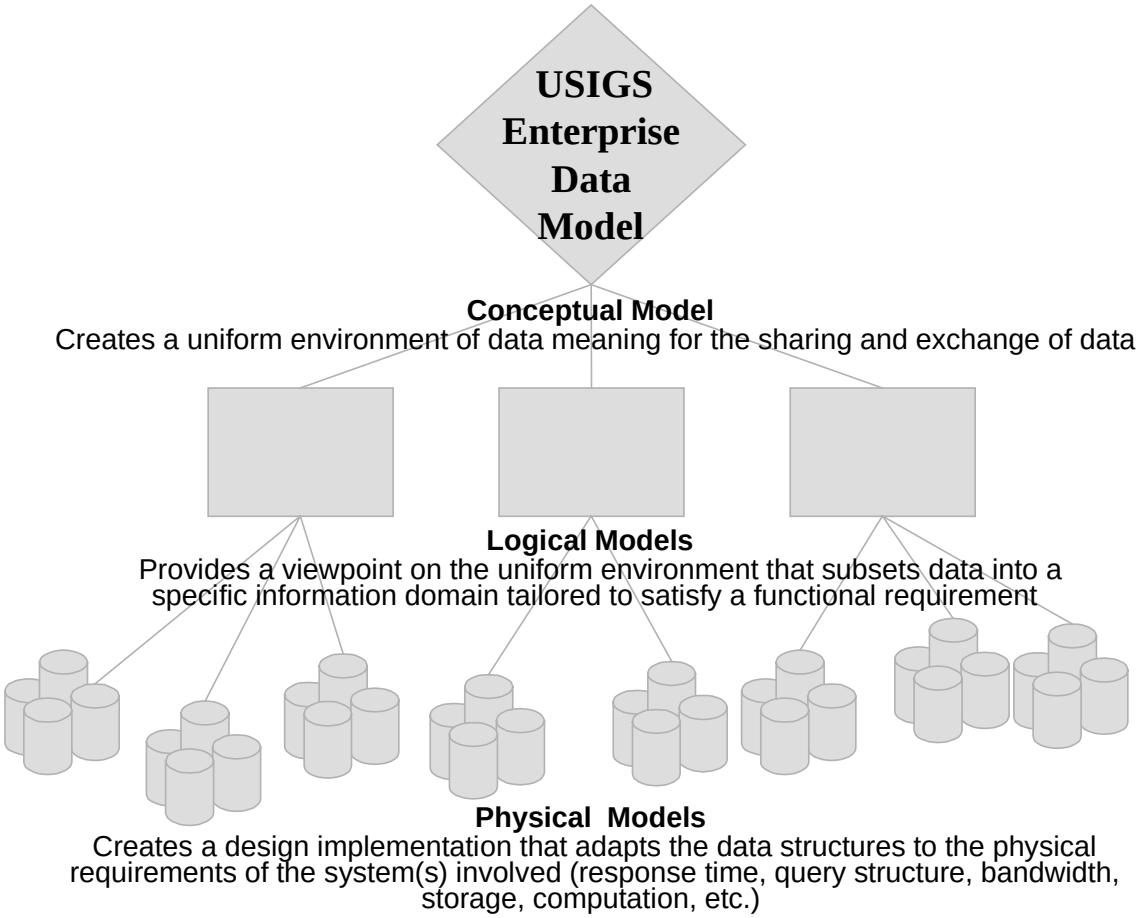


Figure 5.2 Relationship of the UCDM/UEDM to Logical and Physical Data Model Implementations

To support each required exchange format, an Application Interface Control Document (AICD) must be written. An AICD translates the geospatial information content, as defined by a DCS, into the specific format of a required exchange standard. For example, AICDs will be needed to enable NIMA to continue to support each of the vector formats for digital geospatial information specified in the DoD Joint Technical Architecture (JTA). The relationship of the UCDM/UEDM to Data Content Specifications and support to specific exchange formats is shown in Figure 5.3.

An example of the value of this approach is development of the Digital Nautical Chart (DNC) Second Edition, which will be based on the Vector Data General Specification. The content of the First Edition specification must be mapped to the NIMA Profile of FACC to standardize feature and attribute definitions. Content requirements for the DNC must be harmonized with the International Hydrographic Office (IHO) specifications for Electronic Navigation Charts (ENCs) to develop the Data Content Specification. An AICD will be required to support output of the DNC Second Edition in VPF to meet Navy requirements. An AICD will also be required to enable NIMA to translate DNC content to and from S57, the IHO standard exchange format for ENC.

Future USIGS standards activities will focus on implementation of open international exchange standards such as ISO/TC 211 Infrastructure, Data Model, Data Administration and Services Standards. NIMA will support appropriate international, national, and commercial efforts to develop open exchange standards for metadata, raster, vector, text, voice, motion video, and web services. NIMA must work to ensure that these developing open standards provide for specialized needs (e.g., extensions to metadata standards needed to address specific thematic or subject matter searches and dissemination of change information for feature and attribute updates).

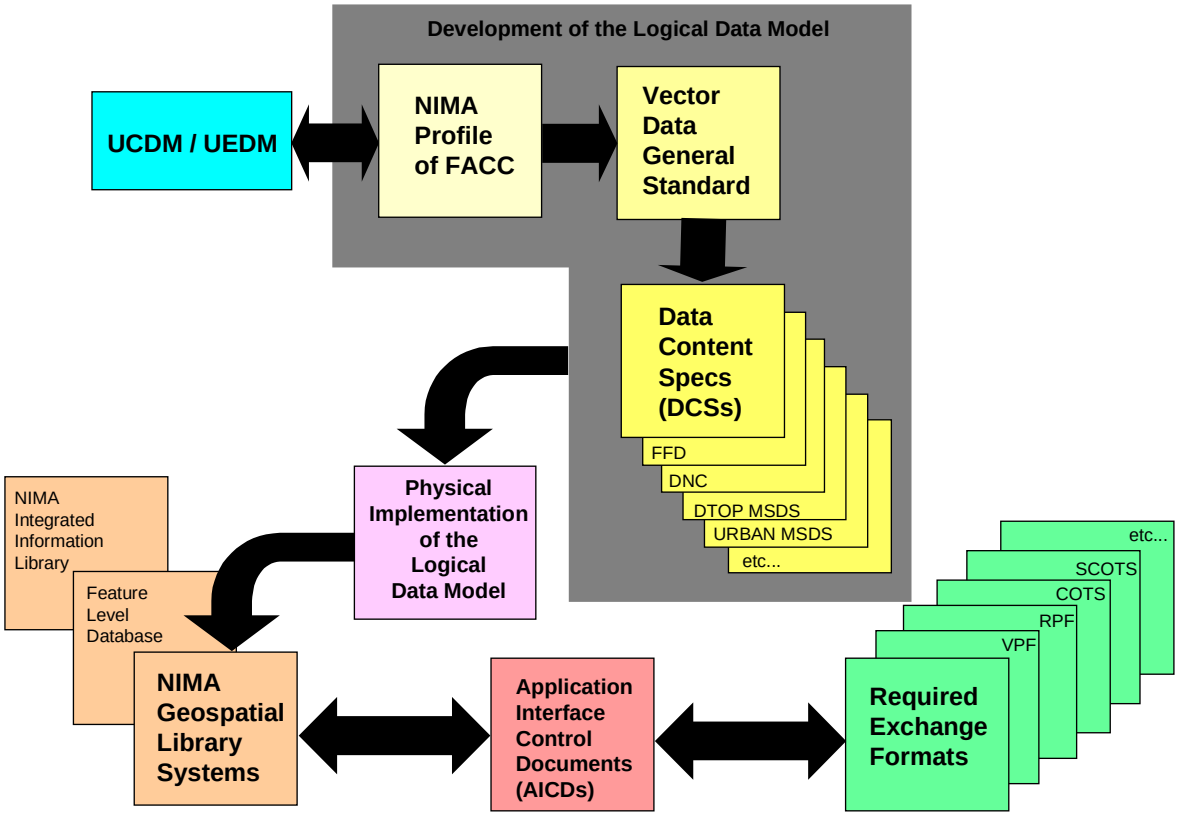


Figure 5.3 Development Path for Exchange Standards to Transfer Vector Data Content

In addition, NIMA will develop a strategy to meet the need for an open exchange format for bulk data transfer using high-density digital physical media. Bulk data transfer will still be required to supply deploying forces with a basic load of geospatial information (i.e., foundation data and any relavent existing MSDS).

5.1.4 Global Vertical Datum for Elevation and Depth Information in NIMA Systems

Unfunded **OPR: NIMA DO**

NIMA will use the World Geodetic System (WGS) 1984 Ellipsoid as the global vertical datum for elevation and depth information collected and managed in NIMA geospatial libraries. WGS 84 latitude, longitude, and ellipsoid heights form an Earth-centered, Earth-fixed three-dimensional reference frame to support NIMA's integrated geospatial information environment. This is especially critical for littoral regions of the world, where a seamless horizontal and vertical frame of reference is required across the land/sea interface.

Referencing all heights to the WGS 84 Ellipsoid allows varieties of applications of the data through introduction of the geoid, mean sea level determinations, standard nautical chart datums, and tidal datums. For example, views of nautical data will be provided with depths referenced to Mean Lower Low Water, as appropriate, to meet requirements for safe navigation, and views of land data will reference elevations to Mean Sea Level (MSL) as defined by the WGS 84 Geoid adjusted using the Earth Gravitational Model 1996 (EGM96).

EGM96 is the most current model employed to generate the WGS 84 Geoid, and using the WGS 84 Geoid for global orthometric heights best satisfies requirements for elevations referenced to Mean Sea Level. NIMA will work to gain international acceptance of the WGS 84 Geoid as the global vertical representation of Mean Sea Level in future international and commercial systems. In addition, NIMA will work with the international hydrographic and topographic communities to develop precise parameters that support both horizontal and vertical datum transformation requirements.

NIMA will continue to pursue gravity collection and modeling activities that will lead to the next global geopotential model beyond EGM96. These efforts will enable refinements that will lead to improved accuracy in the World Geodetic System.

5.1.5 Interoperability of USIGS Information in the Common Relevant Operational Picture

Unfunded **OPR: NIMA DO/AT**

Integrated imagery, imagery intelligence, and geospatial information that will be available from the NIIL will provide the target framework for NIMA support to the CROP in the 2010 timeframe and beyond.

To enable integration of this USIGS information with other domains that support the CROP, NIMA will ensure that imagery, imagery intelligence, and geospatial information complies with requirements of the Defense Information Infrastructure (DII) Common Operating Environment (COE) and Joint Technical Architecture (JTA). To test interoperability with other information domains in the CROP, NIMA will prototype the integration of USIGS information with other information domains. Example information domains that may be addressed in this activity include signals intelligence, operations, weather, and logistics.

Prototyping activities will exercise geo-linking capabilities across information domains. Components of information in one domain may be linked to components in another domain if they share a common location or other geospatial reference information. For example, a

power plant feature accurately geolocated in the NIIL may be linked to information in an Intelligence Community database. The Intelligence Community database may identify the purpose of the plant and its generating capacity. Prototyping activities must address issues such as:

- Fusion of multi-source, or multi-INT, information into a coherent and conflated picture of the mission space, and
- Linking spatially referenced information from multiple sources.

5.2 Data Content Specifications and Presentation Specifications

5.2.1 Foundation Data (FD) and Mission-Specific Data Set (MSDS) Data Content Specifications

Funded **OPR: NIMA PCO/DO**

NIMA will complete Data Content Specifications (DCSs) for vector data FD components and develop the first comprehensive set of MSDS DCSs for air, land, urban, littoral, and ocean areas. These content specifications will be developed in conjunction with NIMA customers and define the required geospatial information, accuracy, density, and currency – based on intended uses.

The content of FD and MSDS described in these specifications will enable users, when accessing feature-level databases in the future, to construct a wide variety of prescribed and tailored "views" of the mission space. DCSs will enable users to perform directed database searches to support their specific information needs and/or presentation requirements. The Army and the Marine Corps have stated that DCSs are a "starting point" for articulating requirements for "tailored" geospatial information.

5.2.2 Presentation and Symbolization Specifications

Funded **OPR: NIMA DO/IS**

Along with DCSs, NIMA will develop presentation and symbolization specifications to define prescribed "views" of the mission space. For the transition to digital geospatial information to be successful, users must be able to select pre-defined "views" with the click of a button. An example of a prescribed view is presentation of geospatial information similar to the content and symbolization of a traditional map product.

"Recipes" define the ingredients and processes required to generate prescribed views. Ingredients include the content (e.g., features, elevation data, and imagery), marginalia information, and symbolization and presentation criteria.

NIMA's Geospatial Symbology (GeoSym) is the current standard for symbolizing digital geospatial information. As DCSs are developed for FD and MSDS, GeoSym will be reviewed and updated to support evolving symbolization and presentation requirements. This will support not only pre-defined "views," it will also allow users to build new tailored "views" to meet changing mission needs.

6 Information Management

6.1 File-Based Information Management Environment

6.1.1 NIMA Geospatial Storage System (NGSS) and Digital Products Data Warehouse (DPDW)

Funded **OPR: NIMA DO/AT/IS**

The NGSS serves as a central repository accessible via NIMA's Intranets to support internal acquisition, production, and management for foundation-based operations. This system, coupled with the capabilities of the Digital Products Data Warehouse (DPDW), provides the file-based near-term solution for the NIMA geospatial library. NIMA will expand NGSS file management capabilities, storage capacity, and network access to give internal NIMA users access to selected foundation data and MSDS holdings – currently held as individual product files.

New and updated foundation data files will be automatically posted from NGSS to the NIMA Gateway. This improves customer access to current NIMA imagery and geospatial information, and it reduces or eliminates labor-intensive manual file transfer processes currently in use.

6.1.2 Migration of Selected Digital Product Files into a Consolidated File-Based Storage Architecture

Partially Funded **OPR: NIMA DO/IS**

NIMA's current digital product files are stored across a wide array of data warehouses, tape libraries, production systems, and local workstations. NIMA will implement standard metadata for these files so appropriate files may be migrated to a consolidated file-based storage architecture as a follow-on to the NGSS and DPDW. Standard metadata will allow NIMA to catalog and manage geospatial information files. They will also enhance discovery and retrieval of files from the consolidated file-based storage architecture and from the NIMA Gateway.

Maintaining appropriate files in the consolidated file-based storage architecture not only facilitates NIMA's shift to acquisition and production of foundation data and MSDS, it also supports implementation of readiness assessment based on the "utility" of available geospatial information.

6.1.3 Enhancements to Store and Manage Additional Geospatial Information Files

Unfunded **OPR: NIMA AT/IS**

NIMA will enhance the consolidated file-based storage architecture to store and manage additional imagery and geospatial information files. These include commodity data buys such as the Land-Use/Land-Cover and soils databases. They also include new sources such as Shuttle Radar Topography Mission (SRTM) data and multispectral and hyperspectral imagery. Storage must also be provided for acoustic imagery that will be available from Navy collectors such as the Precision Undersea Mapping (PUMA) sensor system.

6.2 Feature-Based Information Management Environment

6.2.1 Feature-Level Database (FLDB) Development

Partially Funded **OPR: NIMA AT/IS**

As an interim step toward achieving an object-based data environment, NIMA will prototype and implement a COTS-based FLDB – this serves as a mid-term solution for the NIMA geospatial information library. The FLDB is a NIMA distributed-architecture production database that will store and manage point, line, and polygon features and their associated attributes based on a physical data model implementation of the UCDM. The FLDB will also store elevation information for FFD and MSDS.

The FLDB begins to analyze and conflate multiple instances of geospatial feature and attribute information. This is an important step in preparing existing geospatial information for migration into the target object-based environment of the NIIL.

As part of the FLDB development, interfaces will be established between NIMA's existing production systems and databases. This will support migration of legacy geospatial information into the logically integrated FLDB. From this new library, geospatial information can be extracted and for generalized or intensified to meet requirements of NIMA customers.

The FLDB is funded under NIMA's current program; however, additional funding is required to accelerate development and implementation.

6.2.2 Data Authority Determination for Migration and Maintenance

Funded **OPR: NIMA DO**

In the FLDB, the UCDM serves as the complete conceptual list of geospatial information entities. To support the migration and maintenance of entities into the FLDB, each entity must be mapped to existing systems responsible for capturing and maintaining that entity.

This mapping will establish the authoritative source for each entity. These authoritative sources become part of the migration planning of existing data stores into the FLDB and ultimately to the NIIL. This process should significantly reduce or eliminate redundancy between databases and maximize production and maintenance efficiencies.

6.2.3 Migration of Existing Feature Information into the FLDB

Unfunded **OPR: NIMA DO/AT/IS**

NIMA will evaluate the loading of appropriate geospatial information from the NGSS and DPDW into the FLDB and prototype the conflation process. The results of that work will be assessed to determine the rate at which additional loading and file conflation will proceed.

NIMA will evaluate other legacy databases and data libraries to determine if the information they contain can migrate into the FLDB environment or whether migration will occur directly into the NIIL at a later date.

6.2.4 Linking Imagery Analysis and Geospatial Information

Unfunded **OPR: NIMA AT**

NIMA will implement interfaces between the FLDB and/or NIIL, geospatial production systems, and selected imagery analysis systems to begin to link imagery analysis and geospatial information. This effort will:

- Translate a selected set of imagery analysis information into the USIGS Enterprise Data Model,
- Expand Integrated Exploitation Capability (IEC) workstations for Image Analysts to capture and exploit geospatial information, and
- Prototype the integrated information environment.

Linked imagery analysis and geospatial information will be available to support foundation data and MSDS production and to support integrated analysis for the tailored information needs of NIMA customers.

6.3 Object-Based Information Management Environment

6.3.1 "One-Touch" Maintenance Environment Prototype

Funded **OPR: NIMA AT**

NIMA completed a prototype of the target architecture for the NIIL through the "Big Idea" initiative. The "Big Idea" tested concepts for NIMA's future database maintenance environment. It assessed the feasibility of achieving a collaborative "one-touch" information maintenance environment with enhanced access and navigation to geospatial information. In the object-based environment of the NIIL, features will be stored one time and used to support a multitude of output representations and scales – from high-resolution MSDS to planning-level FFD and more generalized, smaller-scale views. This design offers the potential to greatly reduce the cost of information maintenance.

Geospatial information successfully migrated and integrated into the FLDB will become the primary source for loading the NIIL. Under the FLDB initiative, interfaces between the feature environment and architectures tested under the "Big Idea" initiative will be developed to prototype future loading of the NIIL.

6.3.2 NIMA Integrated Information Library (NIIL)

Unfunded **OPR: NIMA AT**

The long-term solution for the NIMA geospatial information library is migration to the object-based environment of the NIIL as shown in Figure 6.1. NIMA will implement a SCOTS architecture with distributed object-based libraries. These libraries will store imagery, imagery intelligence, and geospatial information in an integrated data architecture that is based on an implementation of the enhanced UCDM. NIMA will migrate information from the FLDB and from other data repositories into a "one-touch maintenance" environment to achieve seamless, interoperable geospatial information.

NIMA will also migrate appropriate imagery and imagery intelligence information and achieve a fully integrated data capture and maintenance environment. This future integrated digital information infrastructure is key to achieving the full potential synergy of imagery and geospatial information associated with the standup of NIMA.

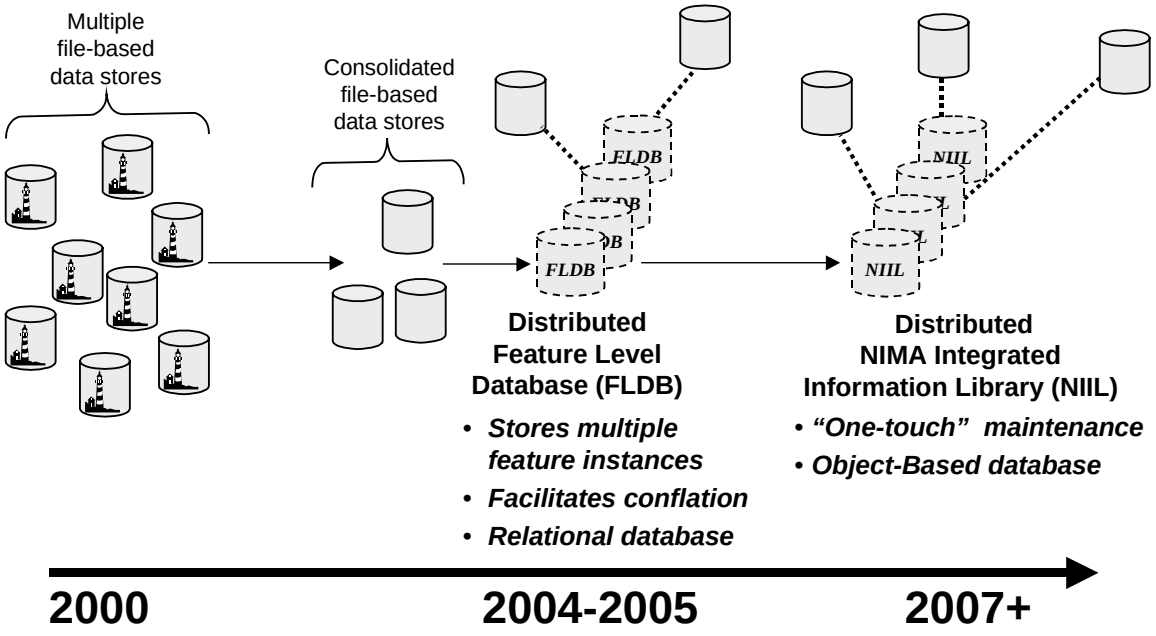


Figure 6.1 Migrating to the "One Touch" Maintenance Environment of the NIIL

6.4 Sustainment and Migration of other Legacy Production Systems into NIMA's Integrated Information Environment

6.4.1 Sustainment of Aeronautical Production Systems

Funded	**OPR: NIMA DO/AT/IS**

NIMA will maintain existing Aeronautical Migration System (AMS) software to support collection, processing, management, and dissemination of safety of navigation information.

6.4.2 Migration of Aeronautical Production Databases to the FLDB and/or NIIL

Funded	**OPR: NIMA AT/IS**

As shown in Figure 6.2, over the mid-term (FY04-05), NIMA will migrate the Aeronautical Digital Data Environment (ADDE) into the distributed architecture of the FLDB. The ADDE supports the Automated Air Facilities Information File (AAFIF), Digital Aeronautical Flight Information File (DAFIF), and Flight Information Publication (FLIP) products.

Vertical obstruction data (VOD) is currently produced and maintained in the text-based Digital Vertical Obstruction File (DVOF). NIMA will migrate DVOF into the FLDB environment – this will support conflation of VOD and aeronautical features with geospatial information generated to populate FFD and MSDS. In the long-term, NIMA will migrate aeronautical safety of navigation databases into the distributed architecture of the NIIL.

Along with the migration of these databases, NIMA will upgrade legacy Aeronautical Migration System (AMS) workstations to improve the processing and finishing of aeronautical information.

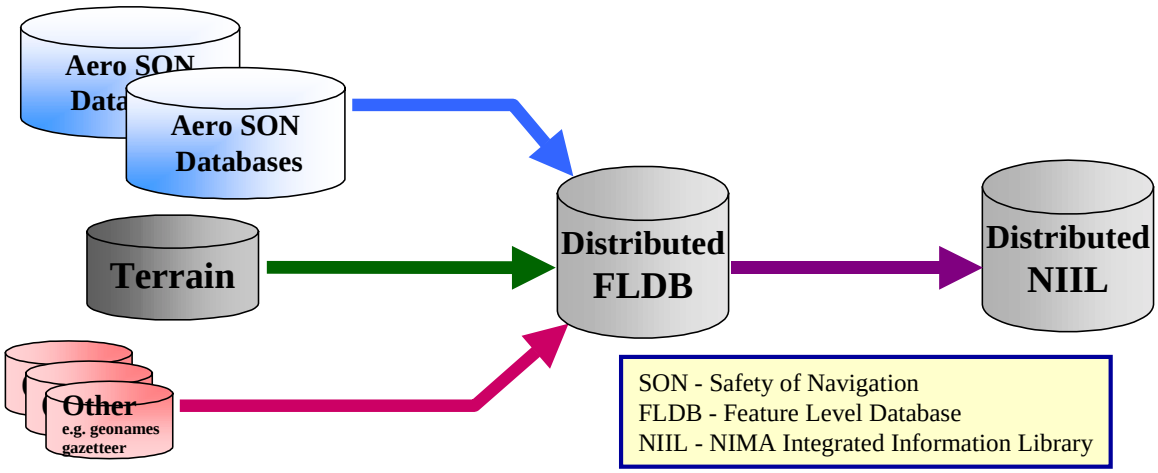


Figure 6.2 Migration of Aeronautical Safety of Navigation and other Legacy Databases into the Distributed Architectures of the FLDB and NIIL

6.4.3 Development of the Flight Information Publication (FLIP) Chart Production Environment

Funded **OPR: NIMA DO/AT**

NIMA will develop the capability to extract FLIP Enroute Charts and Instrument Approach Procedures from the ADDE and follow-on FLDB environment. This FLIP Chart Production Environment (FCPE) will support Digital-to-Plate (DTP) printing and will make digital files available for web access.

Until the FCPE is fully implemented, NIMA will support manual production of Instrument Approach Procedures in the VOLPE format (developed by the VOLPE Center – part of the US Department of Transportation) as required to improve navigation safety. When the FCPE is fully operational, the VOLPE format will be supported through the DTP printing process.

6.4.4 Digital Aeronautical Flight Information File (DAFIF) Updates

Funded **OPR: NIMA DO/AT**

The FLIP Coordinating Committee, made up of representatives of the three Services, has levied a standing requirement on NIMA to update the DAFIF structure/format every two years. This corresponds to the upgrade schedule of the DoD flight management and mission planning systems. NIMA will complete the updates to meet the required schedule.

6.4.5 Conversion of the Digital Vertical Obstruction File to Vector Product Format

Unfunded **OPR: NIMA DO**

NIMA will implement a translator to convert the Digital Vertical Obstruction File (DVOF) from its current-text based format into VPF for dissemination to NIMA customers as Vector Vertical Obstruction Data (VVOD). This will enable vector vertical obstructions (point, line, and area vertical obstruction features) to be displayed and overlaid in geographic information systems and visualization applications.

Conversion of DVOF from text format to points, lines, and polygons will also support migration of vertical obstruction data (VOD) into the FLDB. This will enable conflation of

VOD with other geospatial information generated to populate FFD and MSDS. VOD will also benefit from conflation of other aeronautical data from the ADDE in the FLDB. At that point, required outputs of DVOF and VVOD will be supported from the VOD maintained in the FLDB. In the long term, VOD will be part of the integrated aeronautical information migrated to the "one-touch" maintenance environment of the NIIL.

6.4.6 Implement the Aeronautical Source Environment

Unfunded **OPR: NIMA DO**

Increasing amounts of aeronautical source data are available in digital form. NIMA will implement an Aeronautical Source Environment to provide the capability to receive, process, and archive these sources. As part of the development of the Aeronautical Source Environment, NIMA will implement an AICD to be able to convert data to and from the Aeronautical Information Exchange Model (AIXM). AIXM is an international format standard that supports exchange of aeronautical information between heterogeneous database systems.

6.4.7 Near-Term Development and Sustainment of Maritime Safety and Hydrographic Production Systems

Partially Funded **OPR: NIMA AT/IS**

In the near-term, NIMA will support sustainment of Data Capture and Finishing Environment (DCAFE) workstations used in production and maintenance of DNC and Tactical Ocean Data (TOD). Over the mid-term, these workstations will be replaced by Integrated Exploitation Capability (IEC) workstations.

NIMA will sustain and upgrade systems that support classified Navy programs requiring specialized TOD (referred to as Chief of Naval Operations (CNO) Special Production) as well as develop software to support additional types of TOD required for deployment of the Navy's new attack submarine.

NIMA will also sustain the Navigation Safety System (NSS) and the Hydrographic Source Assessment System (HYSAS). Geospatial information generated by these nautical production systems meets critical safety of navigation requirements.

System support for CNO Special Production and for HYSAS is funded in NIMA's current program. Sustainment and near-term development for the remaining maritime safety and hydrographic production systems require additional funding.

6.4.8 Near-Term Development and Sustainment of the HydroVision NIMA Production Cell

Partially Funded **OPR: NIMA DO/AT**

Near-term, NIMA will continue insertion of object-oriented technology in the HydroVision NIMA Production Cell (NPC). The development is a precursor to the Nautical Database Maintenance Environment (NDME) that will serve as an operational model for longer-term development of the NIMA Integrated Information Library (NIIL).

NIMA will load DNC data into the object-oriented database of the HydroVision NPC, and NIMA will develop processes to establish continuous maintenance on DNCs needed to support operational deployment of Navy's "Digital Bridge."

6.4.9 Development of the Nautical Database Maintenance Environment

Unfunded **OPR: NIMA DO/AT**

The NDME will upgrade existing maritime safety and hydrographic production capabilities. It will replace the legacy NSS and HYSAS source data processing and information finishing tools. Development will leverage off the object-oriented environment implemented in the HydroVision NPC. The relationship of the NDME to the FLDB and NIIL is shown in Figure 6.3.

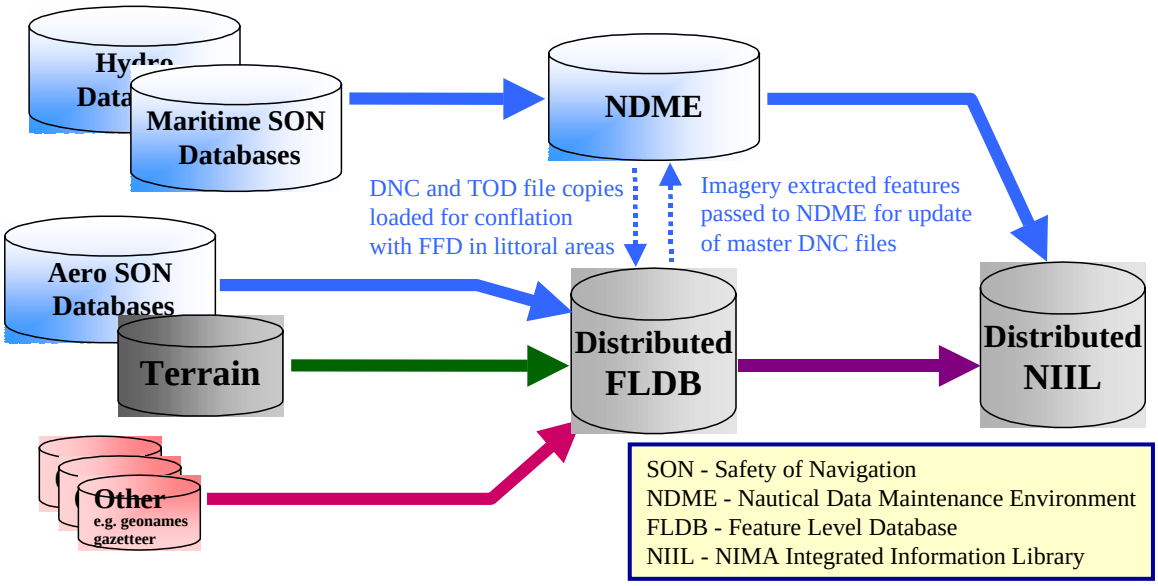


Figure 6.3 Migration of Maritime Safety and Hydrographic Databases into the NDME and into the Distributed Architecture of the NIIL

NDME will be based on the scheduled upgrade to Integrated Exploitation Capability (IEC) workstations and migration of maritime safety and hydrographic databases to a fully integrated object-based environment. It will result in a seamless, authoritative hydrographic database that is maintained on a source arrival basis and used for all maritime safety information. In the mid-term, DNC and other maritime information from the NDME will be made available for loading in the FLDB. The FLDB environment will focus on conflation of FFD, MSDS, and DNC information to support generation of Littoral MSDS. In addition, maritime features extracted from imagery as part of FFD and MSDS production will be provided to the NDME environment to improve the accuracy and currency of maritime safety information.

In the mid-term, NDME will be an operational model for development of the NIIL. Longer-term, the goal of NDME implementation will be to assure that it can serve as a node in the distributed database architecture of the NIIL.

6.4.10 Nautical Data Format Conversions

Unfunded **OPR: NIMA DO/AT**

NIMA will implement an AICD and convert DNC files to the format specified by the International Hydrographic Office (S57) for exchange of electronic chart files. The AICD

will also support conversion of files produced by hydrographic offices around the world in S57 format into DNC file format.

Ability to convert to and from the S57 format will enable NIMA to exchange electronic chart information with the international community. It will also provide a valuable new source of up-to-date and accurate geospatial information that can be used to populate NIMA's integrated information environment and substantially improve global readiness.

6.4.11 Development of a Processing Capability for the Precision Undersea Mapping (PUMA) Sensor

Unfunded **OPR: NIMA AT**

The Precision Undersea Mapping (PUMA) sensor system will provide US submarines with the capability to collect acoustic imagery and digital bathymetry. PUMA-generated data will support 3D mapping of the ocean floor within and beyond the littoral zone.

NIMA will provide for quality control and archiving of acoustic imagery and will implement processes to downgrade classification of the imagery for broader dissemination. NIMA will also implement capabilities to extract and attribute features from PUMA-generated data to support production of DNC, Littoral Warfare Data (LWD), TOD, and other required MSDS.

6.4.12 Sustainment and Migration of the Geospatial Sciences Center (GSC) Production Systems

Funded **OPR: NIMA DO/AT**

In the near-term, NIMA will sustain the existing GSC production systems. In the mid-term, NIMA will plan for their migration into the distributed architecture of the FLDB. GSC production workstations will be upgraded through the Integrated Exploitation Capability (IEC) workstation program.

7 Information Acquisition and Production

7.1 Exploitation-Ready Information

7.1.1 Automated Processing

Partially Funded **OPR: NIMA DO/AT**

NIMA will prototype automated production of selected geospatial information to leverage advances in imagery and multi-sensor processing. Candidates include:

- Reflective-surface digital elevation models (DEMs),
- Orthophotos and Controlled Image Base (CIB),
- Triangulation and geopositioning,
- Targeting support and Digital Point Positioning Data Bases (DPPDBs),
- Change detection, and
- Automated extraction of selected features such as Vertical Obstruction Data (VOD).

Selected capabilities will be prototyped under NIMA's current program. Others will be prototyped as funding is available.

7.1.2 Bare-Earth Elevation Data

Unfunded **OPR: NIMA DO/AT**

NIMA will support prototyping efforts to generate bare-earth elevation data or convert reflective-surface elevation data to bare earth. Based on demonstrated capabilities, and after review and validation, these technologies will be transitioned into operational systems.

7.1.3 3D Site Models

Unfunded **OPR: NIMA DO/AT/IS**

NIMA will implement an operational production capability for automated or semi-automated generation of three-dimensional site models. A 3D wireframe model may be produced if sufficient imagery is available to cover various observation angles around a site. The wireframe models may be draped with high-resolution imagery to provide detailed texture and feature data. The resultant 3D site models provide valuable information for military operations in urbanized terrain (MOUT). Each geospatial information regional team will have the capability to generate these models in accordance with customer requirements and their associated priorities.

7.2 Information Acquisition/Production and Maintenance Strategy

7.2.1 Acquisition/Production Strategy

Funded **OPR: NIMA DO**

NIMA will develop, execute, and continually refine an acquisition and production strategy that will:

- Continue to work to fully explore and develop opportunities to leverage data from the national and international community through partnerships and coproduction agreements.
- Leverage data from alternative sources. NIMA will assess available data to determine its ability to satisfy standing requirements associated with an intended use. Data determined to be the best available in an area and that can satisfy standing requirements will be acquired and hosted on the NGSS. If the data satisfies currency and accuracy standards, NIMA will integrate it into the FLDB (supporting both Foundation and MSDS needs) and eventually the NIIL. See Figure 7.1 for an illustration of the process.
- Establish new information acquisition methods. For example, contractors may be allowed to retain use and sale rights to certain types of information (such as transportation networks) that could be collected from a wide variety of open sources. The objective is to reduce overall cost to the government for certain features and coverages and to encourage development of commercially-based data updating processes. If contractors retain rights to certain data, they may be encouraged to update the data to develop commercial sales. NIMA can benefit from increasing contractor motivation and capability to seek out current information and sources for new data. This approach may be considered in situations in which the data type has viable commercial value.
- Emphasize acquisition of commodity geospatial information from vendors who already have a maintenance commitment for the data. This may reduce long-term costs for

maintenance and enhance information currency. Commercial sources for coverages such as population, vegetation, and transportation are candidates for this approach.

- Support implementation of tools for assessing, cataloging, acquiring, and integrating data from alternative sources. Tools are required to provide data accuracy, assess quality and currency, and integrate data into NIMA's geospatial databases.
- Assess the knowledge, skills, and abilities required for information acquisition and integration. Programs will be needed to train the NIMA geospatial information workforce.

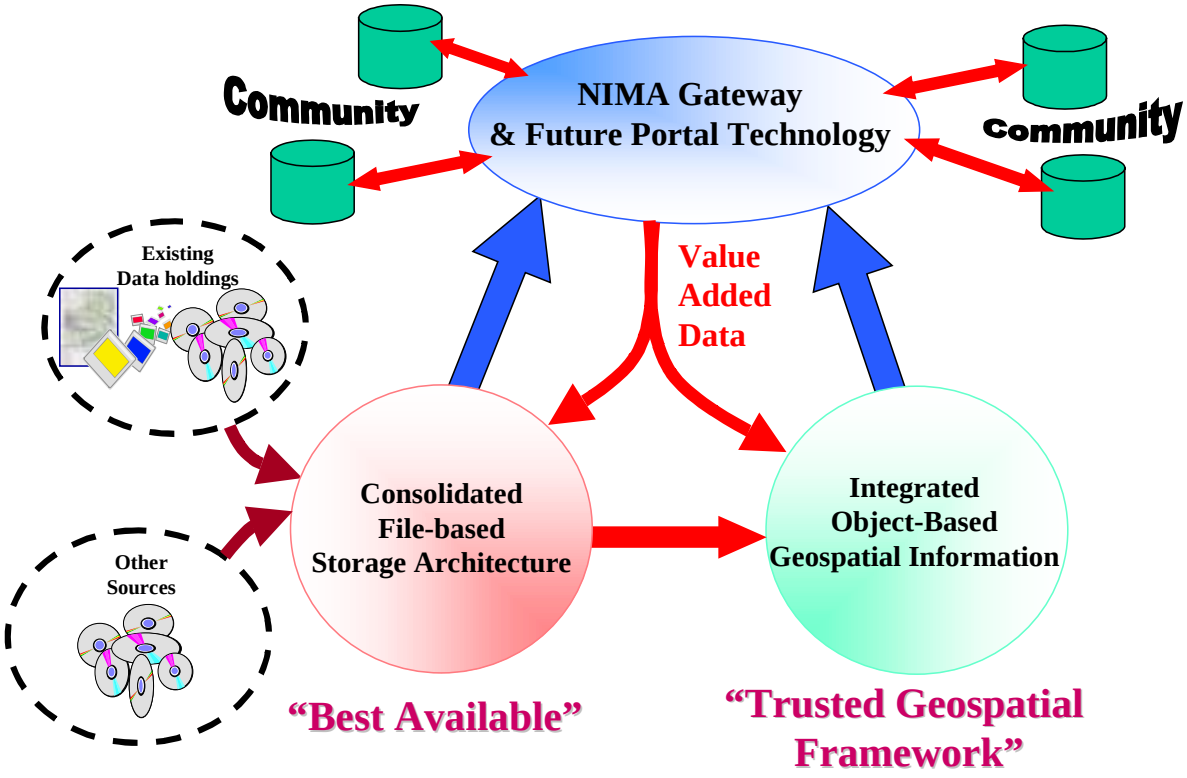


Figure 7.1 Improving Customer Support through the Acquisition/Production Strategy

7.2.2 Maintenance Strategy

Funded	**OPR: NIMA DO**

NIMA will develop and implement a strategy that takes advantage of change detection analysis to initiate maintenance actions for land-based information. The strategy will initially be based on change information available from the recently-acquired global Land-Use/Land-Cover database.

The vendor uses Landsat 5 multispectral scenes to generate the database. New Landsat 7 scenes are automatically compared to Landsat 5 scenes over the same area, and change detection algorithms (applying knowledge-based rules) are used to flag areas of significant change that warrant human review.

NIMA will establish regional priorities and currency requirements to determine whether areas of detected change warrant a maintenance action for information held in the NGSS, DPDW, or future FLDB and NIIL.

This approach implements a sensor-based alternative to NIMA's present "age-based" product review process. The maintenance strategy will be upgraded as change detection capabilities are implemented on operational systems.

7.3 Information Acquisition/Production – Safety of Navigation

7.3.1 Digital Nautical Chart (DNC) and Tactical Ocean Data (TOD) Production and Maintenance

Funded **OPR: NIMA DO**

Although NIMA's hydrographic charts have been digitized under the DNC program, critical shortfalls exist in updating and maintaining this new database with safety of navigation information.

NIMA will outsource the shortfall and use mission partners for coproduction to achieve full maintenance by 2004. This is the target date for Navy's operational transition to an "all-digital" bridge. Outsourcing will also be used to meet the shortfall in the TOD program. TOD is required in conjunction with the DNC to support deployment of the Virginia Class submarine.

7.3.2 Digital Vertical Obstruction File/Chart Update Manual Maintenance

Unfunded **OPR: NIMA DO**

NIMA will outsource aeronautical maintenance to eliminate the backlog in Digital Vertical Obstruction File (DVOF) processing and to maintain Chart Update Manual (CHUM) information. Migration of aeronautical information for these products into the FLDB environment will reduce the cost of future maintenance, since over seventy percent of the information provided in the CHUM pertains to vertical obstructions. In the future, the need for separate products to provide VOD information will be reduced – and eventually eliminated – as digital aeronautical information becomes more readily available through the NIMA Gateway to support mission planning and flight safety systems.

7.3.3 Outsource Aeronautical Library Functions

Unfunded **OPR: NIMA DO**

NIMA will outsource library functions currently performed by personnel in the NIMA Aeronautical Source Office. This initiative will make additional resources available to support aeronautical analyst functions more critical to the maintenance of up-to-date navigation safety information.

7.3.4 Automated Airfield Change Detection

Unfunded **OPR: NIMA DO/AT**

The NIMA Aeronautical Safety Center must periodically review over 22,000 airfields for changes to navigation information. NIMA will continue to support the Focus program, which uses change detection software to automatically process airfield imagery and determine if changes have occurred. The Focus program supports better utilization of

NIMA's resources, since reviews may be focused onto airfields where changes have been indicated.

7.3.5 Vertical Obstruction Detection

Unfunded **OPR: NIMA AT**

NIMA will implement a program to apply automated feature extraction (AFE) software to aid in collecting candidate vertical obstructions. The NIMA Aeronautical Safety Center is currently participating in a National Technical Alliance project to develop this type of capability in conjunction with commercial imagery providers.

7.3.6 Shuttle Radar Topography Mission (SRTM) "Spike File"

Unfunded **OPR: NIMA DO**

Vertical obstructions are a potential byproduct of Shuttle Radar Topography Mission (SRTM) data processing. Spikes in the SRTM terrain elevation data may indicate the presence of vertical obstructions (VO). NIMA will process the SRTM "spike file" to provide an initial near-global coverage of candidate hazards to safe aeronautical navigation.

The SRTM "spike file" data provides valuable VO information over perennially cloud-covered areas. Over other areas of the world, it provides an important indicator to the NIMA extraction workforce to be alert for vertical obstructions. Candidate vertical obstructions will be assessed and validated against other sources as part of FFD and MSDS production.

7.3.7 Airfield Surveys

Partially Funded **OPR: NIMA DO**

NIMA will collect airfield data using the Global Positioning System (GPS) to achieve accurate survey positions. This data will be used to design GPS airfield terminal approach procedures.

NIMA will also use photogrammetric processing to extract elevation data, vertical obstructions, and airfield features to support development of 3D approach models. Together with GPS approach procedures, this data will permit less reliance on ground-based navigational aids.

This work is partially supported under the current program, but additional funding is required to support outsourcing in order to meet NIMA's commitment to complete the collection program and support five-year updates.

7.4 Information Acquisition/Production – Foundation Data

7.4.1 Foundation Feature Data (FFD)

Partially Funded **OPR: NIMA DO**

NIMA currently outsources production of FFD in fully integrated 1° latitude x 1° longitude cells, and the cost per cell has been significantly higher than anticipated. Cost reductions have occurred primarily from changes to the content requirement for FFD rather than from productivity improvements in the commercial sector. As a result, the projection for future FFD cost per cell has remained extremely high.

An analysis of the near-global requirement for FFD provides the potential for a new approach. Certain areas such as North America and Europe offer significant opportunities to reduce average FFD cost per cell through acquisition and integration of available geospatial information from alternative sources.

Analysis also indicates that although the near-global requirement for FFD coverage is 19,200 cells by the end of 2010, setting an objective for covering an area corresponding to about 10,700 cells by the end of 2010 would provide FFD over all high- and medium-priority requirement areas. Lower priority requirement areas would be covered by VMap1 until FFD coverage can be provided beyond 2010.

Availability of alternative sources of geospatial information for certain areas, coupled with reducing the 2010 objective for FFD coverage, provides the basis used in this master plan to project the cost of FFD outsourcing. This approach does not change the total requirement to achieve 19,200 cells of coverage, as represented in the Imagery and Geospatial Capstone Requirements Document (IGCRD). Instead, it proposes to provide FFD coverage over all medium- and high-priority areas by 2010, and to delay completion of the 19,200-cell coverage requirement to beyond 2010.

NIMA will achieve this coverage by:

- Maintaining a core NIMA workforce capability for FFD at approximately 200 personnel. These personnel will also be available to support a core NIMA workforce crisis response capability as required,
- Continuing to develop partnerships with the national and international community for coproduction, and
- Increasing the outsourcing program for FFD to complete 10,700 cells by 2010 based on the availability of additional funding.

7.4.2 FFD Delineation of Drainage and Water Bodies

Unfunded **OPR: NIMA DO/AT**

One of the most labor-intensive coverages within FFD is the delineation of drainage and water bodies. NIMA will prototype methods to reduce the cost of this collection. For example, NIMA will test extraction of large waterbodies and double-line drains using a combination of SRTM data and the Land-Use/Land-Cover database currently being acquired to provide a near-global vegetation coverage for FFD.

NIMA will also procure the near-global soils database being developed by Texas A&M University. NIMA will prototype a method to compute single-line drains using this soils database in conjunction with SRTM elevation data, existing rain models, and watershed models.

7.4.3 Aeronautical Flight and Safety of Navigation Information Integration with FFD

Unfunded **OPR: NIMA DO**

NIMA will integrate planning-level aeronautical flight and safety of navigation information with FFD to support “views” similar to the content provided on a Joint Operations Graphic-Air or an Air Target Chart.

As this content is populated in the shared geospatial framework, it will become the basis for supporting advanced cockpit moving map displays of the future, providing a seamless integrated air picture as part of the CROP.

7.4.4 Seamless Land/Sea Information for Littoral Regions of FFD

Unfunded **OPR: NIMA DO**

NIMA will integrate nautical charting, safety of navigation, and hydrographic information with terrain and near shore information in FFD. Using the WGS 84 Ellipsoid as a global vertical datum for terrain elevations and ocean depths, NIMA will work toward populating a seamless interface across the land/sea boundary in the trusted geospatial framework.

As part of this integration, NIMA will coordinate with the Services to establish interoperable shoreline information for littoral operations. This may include delineation and/or computation of shoreline location at Mean Sea Level and other required vertical datums.

Integration and conflation will eliminate differences between FFD over land and DNC over the oceans to create a seamless global foundation for the shared geospatial framework. Seamless land/sea information supports the development of MSDS content specifications for Navy/Marine Corps littoral missions.

7.4.5 Controlled Image Base

Partially Funded **OPR: NIMA DO**

As represented in the IGCRD, the total requirement for 5-meter resolution Controlled Image Base (CIB) coverage is 19,200 cells by the end of FY05. Under NIMA's current program, CIB-5 will be produced over approximately 14,900 cells by the end of FY05. Additional funding is required to increase outsourcing and complete near-global (19,200 cells) CIB-5 coverage.

7.4.6 Digital Point Positioning Data Base

Partially Funded **OPR: NIMA DO**

The Digital Point Positioning Data Base (DPPDB) program also has a shortfall in available funding for outsourcing. NIMA's current program will complete approximately 6,100 cells of coverage by the end of FY07. Additional funding is needed to address requirements in the IGCRD to accelerate the program and complete DPPDB coverage of approximately 7,100 cells by the end of FY05.

7.4.7 Geopositioning Program

Funded **OPR: NIMA DO**

The need to provide geopositioning for internal and contract production of FFD, CIB, and DPPDB has generated a backlog in the geopositioning program. The backlog creates a shortfall in required control points needed to support geospatial information production and acquisition programs. In-house resources are insufficient to address the requirement, and NIMA will contract for additional support to eliminate the backlog.

7.4.8 Gravity and Gravity Gradiometry Data

Partially Funded **OPR: NIMA DO**

Existing gravity and gravity gradiometry holdings contain areas of poor data quality and areas of no data. Gravity and gravity gradiometry data are critical to inertial navigation systems as well as to smart weapon systems that require the data for navigation and targeting purposes. This data collection shortfall is partially funded in NIMA's current program, but additional funding is required.

7.4.9 Satellite Geodesy

Partially Funded **OPR: NIMA DO**

NIMA will continue to support near-real-time navigation and post-analysis of precise navigation systems that use WGS-84. This effort is funded in NIMA's current program, but additional funding is required to address the increased cost of ephemeris post-processing and of maintaining worldwide tracking stations.

7.4.10 Weapons System Support Modernization

Unfunded **OPR: NIMA DO**

NIMA maintains WGS-84 and its precise 3D reference frame to support requirements for weapons system navigational performance and targeting. Under this initiative, NIMA will implement improvements in the modeling of higher frequency gravity using gravity gradiometry for both advanced inertial navigation systems and activities related to hard and deeply buried targets (HDBT). NIMA will also provide trajectory analysis and model gravity requirements for advanced weapons systems such as TRIDENT.

NIMA personnel currently provide range support for the testing of weapons system and navigation system accuracy. Through this initiative NIMA will continue to provide this support by outsourcing the high-accuracy surveys needed for testing conducted at weapons system ranges.

7.5 Information Acquisition/Production – Mission-Specific Data Sets

7.5.1 NIMA's Core Workforce for the "Readiness and Responsiveness" Strategy

Funded **OPR: NIMA DO**

NIMA will provide a core acquisition/production readiness and responsiveness capability for MSDS support. When not engaged in a crisis, the core workforce will fulfill prioritized requirements for "readiness" MSDS and support other prioritized needs for geospatial information.

7.5.2 Contractor Augmentation to Support NIMA's "Readiness and Responsiveness" Strategy

Unfunded **OPR: NIMA DO**

Workforce modeling indicates that, given NIMA's available resources, the core workforce that can be engaged to support a crisis will not be able to fully meet IGCRD crisis response production requirements for geospatial information. NIMA's plan is to augment the core workforce with contractor support to bring the capability up to the required level.

The IGCRD also specifies a peacetime production rate for readiness MSDS. This geospatial information is needed to support those OPLANs/CONPLANs and Functional

Plans with mission timelines that cannot be met by NIMA's crisis response production capability.

Modeling of the peacetime requirement for readiness MSDS indicates a similar shortfall in NIMA's production capabilities. As a result, this initiative augments NIMA's in-house workforce with the contract personnel needed to meet both the peacetime and crisis response requirements specified in the IGCRD.

7.5.3 Acquisition of High-Resolution Geospatial Information for MSDS

Unfunded **OPR: NIMA DO**

Advances in the generation of high-resolution geospatial information, whether from commercial imagery or GPS data collection efforts, are making available a wealth of data. NIMA will place increased emphasis on identifying, acquiring, assessing, and integrating these new sources to meet the needs for mission-specific geospatial information.

Data that meets the accuracy, currency, and density standards required for MSDS will be candidates for integration into the FLDB and into the future NIIL. Data that does not meet the standards for integration may still provide significant utility. As appropriate, this data will be made available through the NIMA Gateway with appropriate accuracy and currency descriptors. It will be identified as being the best available data that can be used to satisfy standing requirements for mission support for a specific area; see Figure 7.1.

7.5.4 Acquisition of High-Resolution Data to Support Military Operations in Urbanized Terrain

Unfunded **OPR: NIMA DO**

MOUT includes the full spectrum of military actions from non-contested non-combatant evacuation operations (NEOs) to full conflict operations. Geospatial information requirements for MOUT range from fused imagery and high-resolution geospatial features to three- and four-dimensional site models. MOUT also requires specialized urban infrastructure information such as utilities (power, water, communications) and population demographics.

NIMA will identify, assess, acquire, and integrate urban geospatial information from all available sources. Through this initiative, NIMA will leverage collection efforts of the Intelligence Community and employ data mining search tools to locate alternative sources of urban information.

7.5.5 Processing of Precision Undersea Mapping (PUMA) Acoustic Imagery

Unfunded **OPR: NIMA DO**

NIMA will process acoustic imagery collected from the Precision Undersea Mapping (PUMA) sensor system onboard US submarines. PUMA-generated data will provide 3D mapping of the ocean floor to support generation of MSDS such as TOD 3 (Shallow Water TOD) and Littoral MSDS.

7.6 Information Acquisition/Production – Analytical Services

7.6.1 Forward-Deployed Support

Funded **OPR: NIMA PCO**

NIMA will continue to provide forward-deployed support to address the specific geospatial information needs of national, civil, and military customers through:

- technical representatives,
- Customer Support Response Teams (CSRTs), and
- Contingency Response Teams (CRTs).

Technical representatives are permanently deployed to customer sites with modern geographic information system (GIS) workstations. They have the skills to satisfy many immediate mission information needs using available geospatial data. As required, technical representatives can also "reach back" into NIMA and other organizations for additional support.

NIMA deploys CSRTs worldwide to support crisis operations. These may include disaster relief efforts, humanitarian assistance, military operations, or other contingencies. CSRTs deploy for the duration of the mission to augment customer staffs with a combination of skills including end-to-end imagery tasking and exploitation, geospatial information analysis, and computer system operation.

NIMA provides imagery and geospatial support to National Intelligence Support Teams (NISTs) through CRTs. CRTs are composed of geospatial or imagery analysts who are trained and equipped to deploy worldwide on a moment's notice. Once deployed, they become full members of the NIST and provide "reach back" to NIMA in support of the operation.

7.6.2 Reach-Back Support

Funded **OPR: NIMA DO**

In addition to delivering foundation data (including safety of navigation information) and MSDS through NIMA's "readiness and responsiveness" strategy, NIMA will maintain a capability to deliver geospatial analytical services in response to specialized geospatial information needs.

NIMA's geospatial analytical services will provide "reach-back" support for:

- NIMA's technical representatives, CSRTs, and CRTs,
- organic geospatial assets of Commands, Services, and Agencies such as the topographic units in the Army and Marine Corps, and
- Commands, Services, and Agencies with limited or no organic geospatial assets.

8 Exploitation Capabilities

8.1 Integrated Exploitation Capability (IEC) Workstations

Partially Funded **OPR: NIMA AT/IS**

NIMA will migrate from a variety of legacy workstations to an Integrated Exploitation Capability (IEC) workstation based on COTS hardware and software. The IEC

workstations will reduce O&M costs and facilitate technology insertion through routine upgrades of COTS-based applications software.

IEC workstations will be phased in over the POM period to provide enhanced capabilities for the NIMA workforce. As IEC workstations replace legacy production systems, they will be used to facilitate the migration of NIMA data into the FLDB and eventually into the NIIL.

Implementation of IEC workstations into maritime safety of navigation, hydrographic, and geodesy/geophysical production systems will address the unique data processing and information finishing needs of those programs. In addition, IEC implementation will be coordinated with other initiatives, such as the Nautical Database Maintenance Environment (NDME), that provide enhanced capabilities to the future integrated information environment.

The IEC workstation program is funded under NIMA's current program. However, additional funding is required to accelerate replacement of legacy workstations.

8.2 Upgrade IEC Workstations for Spectral Image Processing

Unfunded **OPR: NIMA DO/AT**

Spectral image processing is one of the most promising technologies for improving assisted extraction and attribution of geospatial information. Various military and commercial technology development programs have applied spectral image processing to develop change detection, feature classification, semi-automated target recognition, and semi-automated feature extraction capabilities.

To take advantage of these processing capabilities, NIMA will upgrade a subset of the IEC workstations from the baseline configuration. The upgrade will enable the IECs to handle the increased volume of data associated with mulitspectral, hyperspectral, and ultraspectral imagery. Both intelligence analysts and geospatial analysts will use the upgraded IECs to identify and extract information for the FLDB and the future NIIL.

8.3 Insertion of Research and Development Successes for Exploitation Tools

Partially Funded **OPR: NIMA AT**

NIMA supports research and development activities to identify and develop a variety of new exploitation tools. Through this initiative, NIMA will provide funding to transition research and development successes in critical production areas into operational systems. These include:

- geospatial extraction and feature attribution tools to exploit electro-optical, multispectral, radar, LIDAR, and infrared sensors for terrestrial collection,
- tools for processing hydrographic and bathymetric data from multispectral, LIDAR, acoustic, and acoustic imaging sensors, and
- geospatial processing tools for generalization, symbolization, and visualization.

Funding is available in the current program to upgrade the processing of spectral and radar imagery. Technology insertion for other new exploitation tools requires additional funding.

9 User Information Access, Discovery, and Retrieval

9.1 Gateway Access

9.1.1 User Access to Existing NIMA Holdings

Partially Funded **OPR: NIMA IS**

This initiative is partially supported by the current program. Additional funding is required to provide for significant enhancements to storage and access capabilities of the Gateway.

NIMA will load geospatial information from a variety of standalone data stores onto the Gateway to provide a single integrated access point for NIMA customers; see Figure 7.1. NIMA will make available, via the Gateway, a significant amount of new geospatial information that is expected to become available soon. Examples include the near-global Land-Use/Land-Cover database, SRTM data, and the Commercial Satellite Imagery Library. From a NIMA customer's standpoint, the Gateway will serve as the "one-stop" shopping location for NIMA's information holdings.

9.1.2 Control/Release/License Management Capability

Unfunded **OPR: NIMA IS**

NIMA will implement an automated process on the Gateway for control and release of licensed, copyrighted, or otherwise restricted products and information. This will ensure that restricted/licensed information is provided adequate protection.

When information is requested from the Gateway, the request will be checked against a Control/Releasability Database (CRDB). Through this process, restricted products and information will be filtered based on the requester's access and permissions in the CRDB. They will also be filtered based on intended use and audience.

The same control/releasability requirement exists for licensed products and information when NIMA purchases them for "government only" use or for use by other restricted categories. Requestors not covered by the categories in a license agreement may be required to pay a pre-negotiated usage fee prior to dissemination.

9.1.3 Multi-Domain Dissemination System

Unfunded **OPR: NIMA IS**

NIMA will implement a semi-automated method that allows data to be reviewed and approved for passage from higher-level to lower-level network security domains. This Multi-information Domain Dissemination System (MDDS) is a necessary step to ensure that information is properly reviewed for security and releasability. Since it is anticipated that multi-level security technology will not become operational within the next several years, MDDS is crucial to ensuring data security while increasing the speed of access to a variety of security domains.

9.1.4 Value Adding

Partially Funded **OPR: NIMA IS**

NIMA will provide a capability for USIGS organizations to send "value-added" geospatial information to the Gateway that these organizations have collected and/or produced locally. NIMA will assess value-added data submitted with standardized metadata indicating the quality and lineage of the information to determine its ability to satisfy standing requirements. Data determined to be the best available in an area and that can satisfy standing requirements will be hosted in the consolidated file-based architecture. If it satisfies the currency and accuracy standards to support FFD and MSDS production, the data will be prioritized for integration into the FLDB and eventually into the NIIL; see Figure 7.1.

This initiative is partially funded, however additional funding is needed to achieve the required level of capability for NIMA to leverage value-added data to populate the trusted geospatial framework.

9.2 Leveraging Web-Based Developments

9.2.1 Public Key Infrastructure and Customer Profiles

Unfunded **OPR: NIMA IS**

Public Key Infrastructure (PKI) technology is scheduled to be implemented within the defense community by the mid-term (FY04-FY05) timeframe. This technology will revolutionize geospatial information access within DoD.

NIMA's unclassified, distribution-limited geospatial information is currently available through the Gateway over the OSIS network. Therefore, Gateway access is limited to NIMA customers with OSIS connectivity. NIMA will implement PKI technology to allow all NIMA customers with an Internet connection to have Gateway access.

Through the implementation of the PKI initiative, NIMA customers with Internet access will be able to connect to DoD's NIPRNET and ultimately to OSIS. A personal authentication, verification, and authorization process will control the connection.

Implementation of PKI will require that NIMA develop customer profiles, since access is tied to individual customers and not specific computers. These PKI profiles provide the framework to more fully develop customer information-based profile technology and will support specific customer queries for information via "smart pull." The capability to develop robust customer profiles will also allow NIMA to capture details about customer operations, preferences, and intended uses. In the future, these robust profiles will support "smart-push" announcements of information availability or updates.

9.2.2 Portal Development

Unfunded **OPR: NIMA IS**

NIMA will implement portal technology through web-enabled map servers for appropriate sharing of imagery, imagery intelligence, and geospatial information. This implementation will leverage the successes of NIMA's e-business pilot programs and enable appropriate connectivity to be established between NIMA information stores and stores of imagery and geospatial information populated by the national, civil, military, and international communities.

9.2.3 Portal Connectivity and Presentation Services

Unfunded **OPR: NIMA IS**

NIMA will provide its customers with a single intelligent portal through which they may access physically-distributed USIGS databases of imagery and geospatial information.

NIMA will also implement presentation services accessible through intelligent portal technology. These services will enable NIMA customers to select and assemble data into prescribed "views." Selection, symbolization, and display of information will be based on standardized "recipes" for data content, symbology, and integration of coverages into a "view."

9.3 Dissemination and Downstream Storage

9.3.1 Dissemination via Satellite Broadcast

Unfunded **OPR: NIMA IS**

The operational concept employed by the geospatial information architectures of the military Services includes receiving new and updated geospatial information via a satellite broadcasting capability. Therefore, NIMA will support a satellite broadcast service as part of the standard dissemination methods for digital geospatial information available from the Gateway.

To support satellite dissemination, NIMA will develop the capability to post new and updated geospatial information and update data to the Gateway for transmission to a broadcast services site (satellite injection point) on a daily basis.

9.3.2 VPF Database Update / Vector Database Update Capability

Partially Funded **OPR: NIMA DO/AT**

The updating of fielded Vector Product Format (VPF) files has been a problem because of embedded complex topology structures. However, NIMA has achieved significant progress in the current program toward development of a "patch" for the Digital Nautical Chart VPF file. This VPF Digital Update (VDU) capability will allow NIMA to disseminate new or changed data that becomes available in an area after publishing and disseminating the base VPF file. VDU will significantly reduce communications requirements for dissemination of maritime safety of navigation updates for the DNC.

VDU is funded in the current program to meet Navy operational requirements for the DNC. Additional funding is required to develop a more general vector database update capability for MSDS and vector components of FD that is not tied to a specific exchange format; see Figure 5.3.

9.3.3 Downstream Storage

Funded **OPR: NIMA AT**

Command Information Libraries (CILs) and Image Product Libraries (IPLs) are currently designed to store and manage imagery files. NIMA will upgrade CILs and IPLs to store and manage geospatial information.

9.3.4 Remote Replication System

Funded	OPR: NIMA AT

For the near-term, NIMA will sustain Remote Replication Systems (RRS) deployed to the CINCs and Services. Longer-term, NIMA will provide COTS replacements for RRS.

9.3.5 On-Demand Distribution Services from the Defense Logistics Agency (DLA)

Funded	OPR: NIMA IS and DLA DAPS

DLA Document Automation and Production Services (DAPS) is responsible for providing printing support for DoD, and it performs this mission at 270 locations worldwide. Currently, DAPS is working to support DLA's transition from paper-based business processes to on-demand electronic document processing.

DLA plans to prototype on-demand production services for geospatial information on paper, CD-ROM, and DVD in the European and Pacific Theaters. NIMA will coordinate with DLA on development of this capability. Through this initiative, DLA intends to:

- assess technology to determine the capability to support on-demand services,
- analyze and compare traditional production costs for paper, CD-ROM, and DVD versus on-demand services for those media,
- establish a pilot on-demand production capability for the European and Pacific Theaters,
- implement electronic ordering processes and procedures and a geospatial interface, and
- investigate the integration of ordering procedures for on-demand services with the Global Combat Support System (GCSS).

9.3.6 Future Dissemination Architecture

Unfunded	OPR: NIMA AT/IS

NIMA will plan for development of the next-generation system for disseminating imagery, imagery intelligence, and geospatial information. The future dissemination architecture will incorporate enhancements in portal technology and e-business services to allow customers to take full advantage of the future integrated information requirements process and NIMA's integrated information environment.

10 End-User Tools and Services

10.1 Commercialization of Joint Mapping Toolkit

Partially Funded	OPR: NIMA AT

NIMA shares joint responsibility with the Defense Information Systems Agency (DISA) for development of mapping capabilities for the Global Command and Control System (GCCS). This capability is currently supported by a collection of government-off-the-shelf (GOTS) software and services known as the Joint Mapping Toolkit (JMTK). JMTK provides mapping and geographic information system (GIS) capabilities for use in both GCCS and related DoD command and control systems.

NIMA is funding commercialization of JMTK under the current program. However, additional funding is needed to accelerate the schedule. Implementation of the commercialized version of JMTK within GCCS is planned for FY04.

10.2 Standalone Geographic Information System Capability

Unfunded **OPR: NIMA AT**

As the military Services make more use of digital geospatial information, there is growing demand for a standalone GIS capability. Access to JMTK is limited to those few users who have access to GCCS and related DoD command and control systems. Broader access to GIS capability is required to facilitate needed changes in doctrine, training, leadership, and force structure.

As the functional manager for geospatial information, NIMA will:

- make available commercial licenses for a standard standalone GIS and web client capability at reduced cost, or
- support development and distribution of a no-cost alternative GIS/web client based on software applications such as Falconview.

A standalone GIS and web client capability will improve the user's ability to access, discover, retrieve, and exploit the trusted framework of geospatial information.

10.3 Geospatial Technology Assessment

Funded **OPR: NIMA AT**

Growing user requirements for geospatial capabilities and the variety of available commercial GIS technologies require an organized method of identification and assessment. NIMA will focus the Pathfinder evaluation of needs on those requirements submitted by USIGS organizations through the DOORS (Dynamic Object Oriented Requirements System) process. NIMA will identify, assess, and publish findings on tools and technologies to better exploit increasing amounts of geospatial information to serve an expanding customer base.

In addition, NIMA will expand its technology program to assess the ability of commercial geospatial applications to not only meet functional requirements as standalone products, but also to meet systems and technical architecture requirements. The goal will be to rapidly insert and integrate SCOTS-based applications into formal acquisition programs of USIGS organizations whenever feasible.

10.4 Software Clearinghouse

Funded **OPR: NIMA AT**

NIMA will develop a clearinghouse for GOTS image processing and geospatial applications for dissemination via the Gateway. The clearinghouse will also disseminate COTS and SCOTS applications and any associated updates for which USIGS organizations have purchased a large number of licenses.

NIMA will consolidate and coordinate the purchase of community licenses for software that has a potentially wide application for imagery and geospatial information processing.

License consolidation will save costs through consolidated acquisition rather than having each organization in the community procure individual or organizational licenses independently.

The clearinghouse will also collect and make available for dissemination useful extensions to widely-used GOTS, COTS, and SCOTS applications. Availability of any individual software component from the clearinghouse will not infer NIMA certification (e.g., for accuracy or functionality), since software certification would require additional NIMA funding.

11 Education and Training

11.1 Community Geospatial Information Training Council

Funded **OPR: NIMA HD**

NIMA will establish a Community Geospatial Information Training Council (CGITC) to evaluate and assess the geospatial training needs of military, national, and civil customers. This council is a collaborative USIGS body representing NIMA, DoD (CINCs and Services), the Intelligence Community, and selected co-producers (e.g., Commonwealth Nations). It will review core and mission-specific tasks requiring instruction and assist in identifying and prioritizing current and future training requirements. The CGITC will also:

- identify a standardized, core curriculum to satisfy geospatial training needs,
- promote an awareness of and appreciation for the need of USIGS geospatial training,
- ensure training requirements associated with the implementation of new systems, capabilities, and standards are integrated into training plans,
- promote academic, commercial, and interagency partnerships to satisfy geospatial training needs,
- consolidate purchases of licenses for distance learning through commercial suppliers, and
- evaluate geospatial innovations for their utility within the USIGS.

11.2 Geospatial Analysis Training

Funded **OPR: NIMA HD**

As NIMA migrates to a digital environment, the USIGS will require training in geospatial analysis to fully support both military leadership and national decisionmakers with a broad spectrum of geospatial information. To support DoD requirements, each Service must address the level of leader and technical training required for their occupational fields. The NIMA College will develop and train intermediate and advanced course work in collaboration with USIGS organizations to meet these complex mission requirements. Coursework will incorporate real-world data discovery, access, production, and exploitation in a simulated operational environment. Coursework funded under NIMA's current program includes:

- Basic and Advanced Military Occupational Specialty (MOS) qualification training in geospatial-related fields,
- Geospatial Analyst training to develop a USIGS-wide ability to access, retrieve, evaluate, integrate, analyze, and exploit available geospatial information,
- basic and advanced remotely sensed imagery and geographic information systems courses to familiarize Geospatial Analysts with concepts, theories, principles, and applications,
- geospatial fundamentals needed to understand and exploit geospatial concepts, systems, processes, and procedures within the broad range of USIGS leadership and technical skills,
- military leadership and national decision-maker training on the capabilities of geospatial information and its usefulness in strategic, operational, and tactical decisions,
- expansion of training through the use of alternate delivery methods such as computer-based training/web-based training, video teleconferencing, and mobile training teams,
- training of Marine Analysts to enhance Digital Nautical Chart maintenance and Safety of Navigation production through the use of imagery,
- provision of expanded multi-faceted regional awareness training to allow for sophisticated, comprehensive analysis,
- assistance to the Intelligence Community in incorporating geospatial concepts throughout all phases of intelligence training to facilitate the fusion of imagery, imagery intelligence, and geospatial information, and
- assistance in the widespread implementation of fundamental geospatial education throughout existing military, national, and international training institutions.

11.3 Foundation-Based Operations Training

Funded **OPR: NIMA HD**

The NIMA College will implement training to develop the knowledge, skills, and aptitudes needed to operate in a USIGS geospatial information environment. Revolutionary change is needed to move from production and maintenance of legacy hardcopy products to population and continuous maintenance of a geospatial database from which information and views of the data can be derived. The NIMA College has reprogrammed its budget to substantially increase investment in geospatial training (and/or retraining) for the NIMA workforce, co-producers, and unified data producers in the concepts, principles, processes, and content associated with foundation-based operations. The NIMA College is working to deliver the training identified below. However, assistance will be required from other NIMA directorates in the form of rotational and adjunct faculty and subject matter-experts for full implementation. Needed training includes:

- foundation data and mission-specific data set creation to populate and maintain the FLDB/NIIL and derive desired information and views from the data,
- advanced sensors to fully understand their capabilities and limitations for the purposes of exploitation,

- the USIGS Conceptual Data Model to fully understand standard geospatial terminology and ensure interoperability across systems and software applications as well as future web-based applications using Geography Markup Language (GML),
- data evaluation, quality control, and quality assurance of NIMA-produced geospatial data as well as that of NIMA contractors, international partners, unified data producers, and commercial suppliers,
- production systems, concepts, procedures, maintenance, and tools,
- development of standardized lessons (as determined by the CGITC) for insertion into Service staff and leadership training, and
- establishment of fundamental knowledge management for internal NIMA and external managers.

12 Summary

The growth in coverage, density, accuracy, and currency requirements for imagery and geospatial information continues to outpace funded USIGS improvements in source availability, processing capabilities, digital information infrastructure, and exploitation tools.

To address this challenge, NIMA will transition to foundation-based operations by the end of FY05. NIMA will phase out legacy production methods and apply resources to developing the trusted geospatial information framework. The framework will support USIGS requirements for visualization, analysis, and accurate referencing of related geospatial information from other providers. As shown in Figure 12.1, the geospatial implementation initiatives contained in this plan are required for the FY03-07 timeframe to move NIMA toward an interim and ultimately an objective geospatial capability.

As these initiatives are funded and implemented, NIMA will collect lessons learned and apply metrics to better understand the strengths and weaknesses of the current plan. Course corrections will be derived and adjustments made to the USIGS program. Close coordination will continue to be required in order to ensure the operational requirements of today's forces are met while seeking to identify needed funding for the objective capability. Through this process of review and update, NIMA will:

- maximize application of available resources to provide capabilities that directly and measurably improve the coverage, currency, accuracy, and density of geospatial information,
- target infrastructure investments that enhance productivity of the geospatial information workforce and support transition to foundation-based operations,
- take advantage of cost-effective commercial solutions to meet shortfalls in information, processes, and technology, and
- emphasize the importance of training and experience both for NIMA and USIGS to achieve the objective capability.

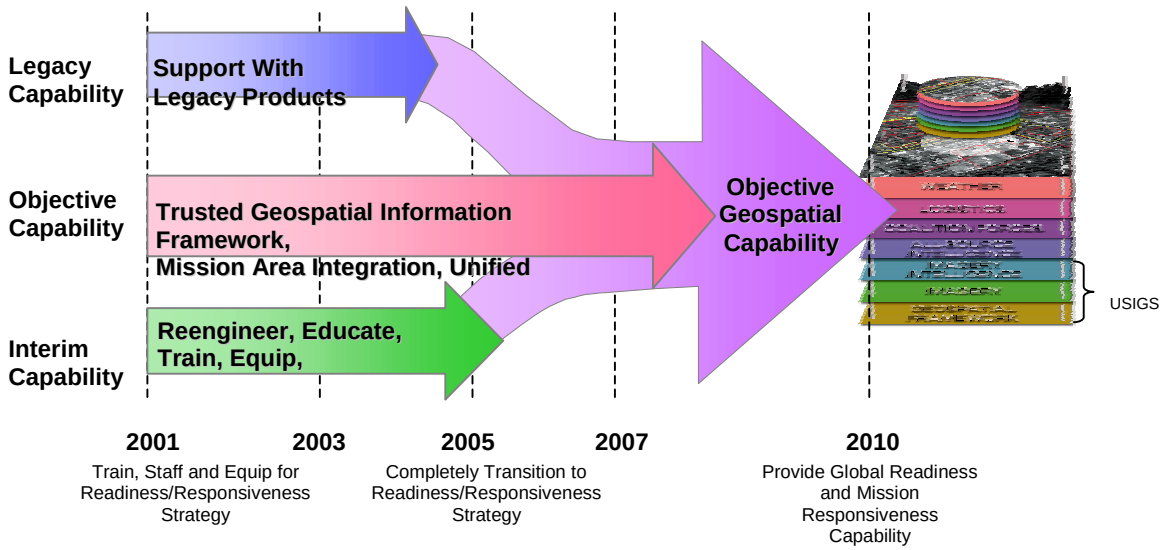


Figure 12.1 Implementing a Trusted Geospatial Information Framework

In order to transition to the readiness and responsiveness strategy, NIMA will focus its acquisition and technology programs on the shortfalls in critical areas addressed in the operations concept and this master plan. The ever-widening gap between requirements and capabilities cannot be closed without support and input from an aggressive information technology program.

To further leverage critical digital infrastructure resources, NIMA will emphasize industry and government partnerships. Only through partnerships can NIMA and the rest of the USIGS organizations hope to go beyond the limits of evolutionary advancements. "Leap-ahead technologies" will be realized through rapid insertion of new SCOTS-based technologies as well as through a focused research and development program.

III. Recommendations

The following recommendations are made to ensure that the vision and goals of the Geospatial Transition Plan are implemented.

1 NIMA, with its mission partners, must market the Geospatial Transition Plan.

The marketing needs to:

- Improve awareness and understanding among senior intelligence and defense leaders on NIMA's plan to provide the "ground truth" that is essential to achieving the DCI's Statement of Strategic Intent and the tenets of JV2010/2020.
- Promote the vision, operational concept, and transition strategy of the Geospatial Transition Plan at the technical and operational staff levels of USIGS organizations.

2 NIMA, with its mission partners, must implement the readiness and responsiveness strategy as a critical element of the USIGS 2010 Concept of Operations and its supporting USIGS Operational Architecture.

Implementation of the strategy will:

- Deliver near-global geospatial readiness through accelerated population of foundation data.
- Develop a mission readiness and responsiveness capability that will meet the visualization, command and control, navigation, and accurate positioning requirements for accurate, current, and relevant geospatial information.
- Develop, implement, and continuously update processes and procedures to:
  -Identify, acquire, assess, and integrate geospatial information available from a wide variety of international, national, and commercial sources to accelerate population of near-global foundation data;

  -Intensify foundation data and conflate alternative sources to populate mission-specific data sets (MSDS);

  -Establish metrics to accurately project and annually update the cost of meeting community requirements for FFD and MSDS.
- Provide for continuous assessment of the readiness/responsiveness strategy through training and operational exercises of USIGS organizations as required to develop the associated metrics, capture lessons learned, and plot future course corrections.

3 NIMA, with its mission partners, must develop the digital infrastructure needed to acquire, produce, integrate, manage, maintain, disseminate, and exploit geospatial information from the national to the tactical level.

This infrastructure, when delivered, will:

- Support identification, management, tracking, and reporting of requirements for geospatial information vice products.
- Support acquisition, production, integration, storage, and maintenance of a logically integrated and seamless framework of trusted geospatial information.

- Provide rapid, intelligent access to the digital geospatial information holdings of the USIGS.
- Provide the core visualization and analytical tools needed to exploit geospatial information in the context of specific mission applications.
- Deliver a capability to collect, assess, and integrate value-added information acquired from customers.

4 NIMA, as the Functional Manager for geospatial information, must ensure the interoperability of digital geospatial information across organizations, missions, and systems.

Interoperability will be ensured by:

- Delivering mission-specific data that will facilitate development of Joint and Service doctrine, tactics, techniques, procedures, and training.
- Continuing development of an enterprise data model for imagery, imagery intelligence, and geospatial information.
- Transitioning to open international and commercial models, standards, and specifications.

5 NIMA, with its mission partners, must develop and deliver the high quality education and training programs needed to produce leaders and operators who understand how to exploit geospatial information in the context of achieving information superiority.

These education and training programs will:

- Educate and train decision makers on how to leverage digital geospatial information to achieve information and decision superiority.
- Educate and train technical staffs and operators in the ability to access, retrieve, manage, manipulate, and utilize geospatial information to provide shared situational awareness and actionable advice for decision makers.

6 NIMA, with its mission partners, must integrate the critical tenets of this transition plan into the plans, programs, and operations of NIMA and its mission partners.

Integration of the critical tenets will:

- Ensure that the transition to information-based operations is synchronized across the USIGS.
- Ensure that providers of spatially-referenced information understand how to build upon the trusted geospatial information framework for the Common Relevant Operational Picture and truly achieve shared situational awareness.

Appendix A: Geospatial Input to the 2001 USIGS Functional Manager's Guidance FY04–09

This appendix to the USIGS Geospatial Transition Plan provides input to the USIGS Functional Manager's Guidance (FMG) for Fiscal Years 2004-2009. When issued, the USIGS FMG will deliver planning and programming guidance for NIMA, the Intelligence Community (IC), and Department of Defense (DoD) organizations that provide our nation with the imagery, imagery system-derived MASINT, imagery intelligence, and geospatial information needed to achieve information superiority. The sections below are based on the USIGS Geospatial Implementation Master Plan. The number in parentheses **( )** after each initiative corresponds to a section in the USIGS Geospatial Implementation Master Plan and to the specific initiatives listed in the Roadmap for USIGS Geospatial Implementation at Appendix E to this document.

Ensuring Success

- **Develop Supportive Policy and Resource Environment (3.1)**
  Implementation of the USIGS Geospatial Implementation Master Plan depends on development and sustainment of a supportive policy and resource environment. NIMA will develop a strategy and marketing plan to convey the potential application and value of the USIGS Geospatial Transition Plan (USIGS GTP) to the USIGS. This strategy and marketing plan will address the:
  - importance of developing the trusted geospatial framework to support the Common Relevant Operational Picture (CROP);
  - inability of legacy standard product production systems, processes, and procedures to support the CROP;
  - impact of shifting to foundation-based operations as rapidly as resources will allow; and
  - results of NIMA's efforts to fund the USIGS Geospatial Implementation Master Plan, which provides benchmarks on NIMA's ability to execute the "readiness and responsiveness" strategy.

  NIMA will implement the concepts and directions outlined in the USIGS 2010 Concept of Operations, USIGS Operational Requirements Document, and the USIGS Geospatial Implementation Master Plan based on available resources. NIMA will provide the leadership necessary to assist other organizations within the USIGS to develop and implement supporting plans.

- **Build Alliances with National and International Partners (3.2)**
  The availability and compatibility of geospatial information from national and international partners will play a very important role in achieving NIMA's readiness and responsiveness strategy. NIMA will foster partnerships through promotion of USIGS concepts and work toward adoption of open standards that support sharing and interoperability of geospatial information across organizations, missions, and systems.

- **Build Alliances with Industry (3.3)**
  NIMA places heavy reliance on the commercial sector as an integral element of the USIGS Geospatial Transition Plan. NIMA will, to the best of its ability, ensure consistent and stable contract programs and partnership mechanisms (e.g.,

cooperative research and development agreements (CRADAs), and other cost-sharing vehicles) are established and supported. NIMA will work with the commercial sector to ensure commercial producers are striving for quality information, increased output, and ongoing maintenance by using viable incentive programs. Implementation of the USIGS GTP is based on achieving interoperability through transition to:

- COTS-based software, systems, services, and information;
- open international and commercial exchange standards for geospatial information and web-based dissemination services; and
- timely information conveyed to the commercial sector for its participation in and contribution to the development, population, and maintenance of the USIGS geospatial domain.

♦ **Review Disclosure/Release Policy and Procedures (3.4)**
NIMA will work with the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (ASD(C3I)), and with the DoD Chief Information Officer (CIO) to review disclosure/release policies and procedures. The ASD(C3I) and DoD CIO will be leading efforts to develop solutions and make appropriate changes that will facilitate the sharing of imagery and geospatial information.

♦ **Establish Measures of Success for Customer Satisfaction (3.5.1)**
NIMA will establish metrics to evaluate progress toward meeting its customer information needs. These metrics will quantify the contribution to geospatial readiness and responsiveness provided through the agency's customer support operations, which include NIMA's forward-deployed operations, gateway operations, and analytical services.

♦ **Quantify Geospatial Information Utility (3.5.2)**
NIMA will develop and implement new processes and metrics to support the transition from product- to information-based requirements. The objective is to measure the efficiency and effectiveness of foundation-based operations. Effectiveness refers to NIMA's ability to support USIGS geospatial readiness and responsiveness requirements. NIMA will implement an evaluation process that quantifies the "utility" of available geospatial information. Metrics for information "utility" will consider factors such as coverage, density, accuracy, and currency relative to intended uses. Numerical scores will be weighted for certain intended uses (e.g. currency may be weighted as more important than accuracy for a specific intended use). This utility-based approach will promote exploitation of alternative sources of geospatial information and comparison of competing priorities for allocation of resources. It will also provide better metrics for assessing the ability of NIMA's geospatial information holdings to support USIGS geospatial readiness and responsiveness requirements. Development of the information utility concept is partially supported by the current program, but additional funding will be required through the *USIGS Geospatial Transition Plan*.

♦ **Global Readiness (3.5.3)**
NIMA will develop a measure of global readiness based on the "utility" provided by components of foundation data. Although individual organizations within USIGS have begun to specify requirements for foundation data, there is no overall agreement as to the contribution to readiness. NIMA will provide a collaborative process within USIGS to determine the standards used to assess global readiness.

- **Safety of Navigation (3.5.4)**
  NIMA will work with the USIGS to review and update the accuracy and currency of aeronautical and maritime safety of navigation information. NIMA customers will benefit from more timely updates that will be available when maintenance is performed continuously to refresh content in the trusted geospatial framework.

- **Mission Readiness (3.5.5)**
  NIMA will continue to evaluate mission readiness in accordance with Joint Staff policy and the Joint Monthly Readiness Review (JMRR) process. However, under foundation-based operations, mission readiness will focus on foundation data as the primary component of readiness in conjunction with NIMA's capacity and capability (e.g., availability of source material) to generate MSDS in response to the lead times of the mission. For planned or anticipated operations in which mission lead times are too short for NIMA to respond and produce the required MSDS in time, MSDS will be scheduled for generation in advance.

- **USIGS Performance (3.5.6)**
  NIMA's acquisition and technology program seeks to constantly improve the capabilities and performance of the USIGS. NIMA, in coordination with the USIGS, will work with customers to develop, establish, and track critical standards that impact the overall efficiency and effectiveness of operations. For example, NIMA will track MSDS production standards, throughput rates, and dissemination times to assess and report on improvements related to process reengineering or the introduction of new USIGS capabilities. At the same time, performance measures must also ensure the accuracy and utility of information provided.

- **Establish a Plan to Transition to Open Standards (3.5.7)**
  NIMA will establish a plan and metrics for achieving interoperability through transition to open international and commercial standards. The plan will specifically address implementation of proven standards-based commercial-off-the-shelf (SCOTS) applications and services and open standards for interfaces and geospatial information exchange. Metrics will assist in quantifying potential improvements in NIMA's ability to acquire, manage, and disseminate interoperable geospatial information. NIMA will participate and invest in industry and commercially-based interoperability programs to introduce USIGS requirements. This will encourage leading technology companies to cooperate in establishing open interface specifications that are key to development and fielding of SCOTS solutions that meet specific USIGS needs. By influencing and leveraging evolving open international and commercial standards, NIMA will move from a file-based information management environment toward the object-based environment of the NIMA Integrated Information Library (NIIL). Parts of both the current program and the additional initiatives within the *USIGS Geospatial Transition Plan* support this transition.

- **Establish and Implement Processes to Reduce the Cost of Foundation-Based Operations through Information Acquisition (3.5.8a)**
  NIMA will transition to foundation-based operations and take maximum advantage of the acquisition of imagery and geospatial information available through other government sources, international sources, trade, barter, or cooperative collection/production agreements, and commercial purchases. NIMA will establish processes and metrics for acquiring, integrating, producing, and maintaining foundation data and mission-specific data sets that exploit a wide variety of sources. The metrics

will be used to refine projected internal production resource estimates and outsourcing costs required to meet the geospatial information needs expressed in the Imagery and Geospatial Capstone Requirements Document (IGCRD). Parts of both the current program and the additional initiatives within the *USIGS Geospatial Transition Plan* support this transition.

- **Leverage e-Business Solutions to Improve Customer Access (3.5.9)**
  The explosion of e-business activity in the commercial sector presents an opportunity for NIMA to increase access and reduce dissemination costs for imagery, imagery intelligence, and geospatial information. NIMA will leverage proven e-business practices and begin implementing web-based services. As an example, NIMA will provide selected access to information through portal services and the Intelligence Community Geography Network (IC GeoNet). This and other projects will yield metrics to evaluate potential improvements that are achievable through technology insertion into USIGS. Parts of both the current program and the additional initiatives within the *USIGS Geospatial Transition Plan* support this transition.

- **Participate in Scheduled Exercises, Experiments, and Demonstrations (3.5.10)**
  NIMA will assess elements of the USIGS 2010 Geospatial CONOPS through routine participation in scheduled exercises, experiments, and demonstrations. As part of the marketing plan for foundation-based operations, NIMA will demonstrate the "readiness and responsiveness" strategy in Service and CINC exercises. Through this participation NIMA will collect metrics, develop lessons learned, and plot course corrections to the USIGS Geospatial Implementation Master Plan. Coupled with participation in these exercises, experiments, and demonstrations, NIMA will look for opportunities to involve industry's collaborative pilot programs and demonstrations. This will provide commercial vendors with the most direct opportunities to understand and respond to USIGS community requirements through enhanced SCOTS capabilities.

Requirements Management

- **Implement an Information-Based Requirements Process through Application of Intended-Use Codes in the Requirements Analysis System (RAS) (4.1.1)**
  NIMA's Requirements Analysis System (RAS) is the geospatial information management system used to task the collection, production, dissemination, and exploitation of geospatial information. Modification of RAS is needed to accommodate geospatial information requirements vice product requirements. Through the application of intended-use codes in RAS, NIMA will adapt the requirements management system and begin to accept and manage content-based (information-based) requirements vice product requirements. Modifications to RAS will allow customers to articulate specific requirements for detailed information (such as standard or tailored MSDS). To implement this capability, NIMA will map specific intended uses to the information components that comprise foundation data and mission-specific data sets. Customers will still need to use existing standard index bases for the area of coverage. To support implementation of content-based (information-based) requirements, NIMA will coordinate with the Services to complete development of specifications that define the content of standard MSDS.

- **Rebaseline the Geospatial Requirements Deck for Foundation-Based Operations (4.1.2)**
  As part of its marketing plan, NIMA will lead an effort within the USIGS to fully transition to foundation-based operations and the associated "readiness and responsiveness" strategy. A general announcement by NIMA will initiate this activity by offering a visit to each major customer to explain the initiative and support the customer in the rebaselining process. This will include a review of each OPLAN/CONPLAN and functional plan in the context of the readiness and responsiveness strategy. NIMA will assist in converting existing requirements for standard legacy products to views and information supported from foundation-based operations. NIMA will continue to support the digital data requirements for existing weapons systems as well as requirements for hardcopy when required. Longer-term, NIMA will work with customers to migrate weapons systems to use information derived from the shared geospatial framework. NIMA plans to make digital geospatial information available in selected COTS and GOTS formats as needed to meet customer requirements, and also in new interoperable formats based on open exchange standards. NIMA will initiate 'sunset reviews' of legacy products with the Services as USIGS transitions to foundation-based operations and establishes requirements for FD and MSDS within current OPLANs and CONPLANs.

- **Link Requirements to Production through the Production Management Alternative Architecture (4.1.3)**
  Through refinement of the Production Management Alternative Architecture (PMAA), NIMA will link content-based (information-based) requirements documented in RAS with production management capabilities. This will provide NIMA with the tools to track program status and better allocate resources for foundation-based operations. A series of pilot programs will serve as the implementation of PMAA. Pilots 1 through 3 are funded under the current program, and the linkage to RAS will take place as part of the Pilot 3 program.

- **Develop an Integrated Information Requirements Management Capability (4.1.5)**
  Longer-term, NIMA will develop and field an integrated content-based (information-based) requirements management capability. This future system will address USIGS integrated requirements and production management capabilities for all of NIMA's mission areas: imagery, imagery intelligence, and geospatial information. It will be designed around a shared requirements database (SRDB), and the system will provide order entry and tracking and workflow management capabilities. NIMA will also coordinate with the Intelligence Community's Multi-Intelligence Acquisition Program (IC-MAP) to evolve to an end-to-end Multi-Intelligence Management System as a collaborative community enterprise. The system will provide the USIGS with an online interface that enables an enterprise view of requirements management. This view will show NIMA customers the status of submitted requirements as they are tracked through all phases of information development and delivery to the ultimate customer (i.e. through requirements, tasking, collection, acquisition and production management, workflow, ordering, dissemination, and user satisfaction). NIMA's participation in the SRDB is funded in the current program. Additional funding is required to complete the full system implementation under the *USIGS Geospatial Transition Plan*.

- **Conduct Timely Information-Based Readiness Reviews (4.2.1)**
  NIMA will meet formally with the Joint Staff and authorized submitters of geospatial information requirements every quarter to review approximately one-fourth of the

supported OPLANs, CONPLANs, and initiatives. To meet dynamically changing requirements, NIMA will constantly collaborate with authorized submitters from the CINCs, Services, and Agencies. The goal of this constant collaboration is to assess and redirect ongoing imagery and geospatial information acquisition and production programs. These readiness reviews will yield a quantifiable assessment of NIMA's capability to:

- meet geospatial readiness,
- capture and prioritize new USIGS geospatial information needs,
- build "coalitions" for specific acquisition/production requirements,
- seek out new and timely alternative sources to speed acquisition/production; and
- explore cost sharing opportunities for commercial data that may satisfy otherwise unfulfilled needs.

To support these reviews, NIMA will provide expertise in the use and application of NIMA's geospatial information holdings. NIMA will also work with submitters to eliminate requirements no longer deemed necessary.

♦ **Allocate Production Resources to Optimize Geospatial Readiness (4.2.2)**
Traditionally, NIMA has allocated map, chart, and digital production resources on a product-by-product basis to satisfy specific sheet-by-sheet or cell-by-cell coverage requirements expressed in OPLANs/CONPLANs and functional plans. With the transition to content-based (information-based) acquisition and production, NIMA will achieve greater productivity by allocating resources (both commodity buys and standard production) based on data utility, currency, accuracy, and coverage within a specific regional area. NIMA will evaluate total area coverage, currency, accuracy, and the customer's requirement to increase the information utility as additional geospatial information is integrated into the shared geospatial framework.

Standards Selection/Development and Implementation

♦ **USIGS Conceptual Data Model (UCDM) for Geospatial Information (5.1.1)**
As USIGS defines and implements architectures, the volume of data flowing through archive and dissemination systems and the enterprise network will expand tremendously. A key technology to enable the warfighter of the future to receive, process, and exploit this geospatial data is a common data model to support development of logical data models and physical implementations in a storage environment. For geospatial information, this standard will be based on the USIGS Conceptual Data Model (UCDM). As the need for more timely, relevant, and accurate customized content grows, it becomes increasingly important to take an integrated, enterprise-wide approach to data modeling. Data modeling and the creation of metadata in accordance with community standards are critical to the creation of a global catalog of USIGS content. The UCDM establishes a standard foundation for creating and maintaining information and its associated metadata. Most importantly, use of common terminology from the UCDM will improve both NIMA's and the USIGS' ability to perform data maintenance across existing databases. NIMA will continue to expand development of the UCDM for geospatial information. The Geospatial Standards Management Committee/Imagery Standards Management Committee (GSMC/ISMC) will provide oversight of the UCDM, since its development and implementation must be coordinated with national, international, and commercial standards bodies (such as the Federal Geospatial Data Committee – FGDC). Through

this coordination, NIMA will ensure that logical and physical data models based on the UCDM are interoperable with future standards-based commercial off-the-shelf (SCOTS) solutions available to the community.

- **USIGS Enterprise Data Model for the Integration of Imagery, Imagery Intelligence, and Geospatial Information (5.1.2a)**
  NIMA will enhance the USIGS Conceptual Data Model (UCDM) beyond geospatial information to also address integration of imagery and imagery intelligence. This USIGS Enterprise Data Model (UEDM) will provide the framework for the object-based environment planned in the NIMA Integrated Information Library (NIIL). The UEDM will also provide the basis for exchange of geospatial information across the web through development of a data registry and corresponding web-based schemas for dissemination of integrated imagery, imagery intelligence, and geospatial information.

- **Imagery and Geospatial Information Exchange Standards (5.1.3)**
  Future community standards activities will be based on the UEDM and support open international and commercial exchange standards for metadata, raster, vector, text, voice, motion video, and web services. International and commercial pursuit of these standards has accelerated based on the potential synergistic effects of integrating these technologies across the web. International and commercial advancements have overtaken the intelligence and defense communities' ability to maintain a leadership role. Allowances for community-specific requirements have been made such as the use of extensions to the metadata standard needed to address such issues as thematic or subject-matter searches required by the Intelligence Community.

  In addition, a long-term strategy is needed to develop an open exchange format for bulk digital data using any variety of high-density physical media. Bulk transfer of data will still be required based on the proposed operational concept in which forces deploy with their basic load of geospatial information (foundation data). The new bulk data transfer standard must support content defined using the UCDM/UEDM to provide a single integrated operational picture without conflicts in data content or accuracy.

  Acceptance and implementation of these new standards will coincide with community efforts to migrate to object-based technologies for information storage and maintenance. The NIMA Profile of FACC is mapped to the current UCDM and provides a standardized profile of feature and attribute definitions that can be used for all of NIMA's vector data. Content standards will allow the use of multiple formats for data exchange including VPF, COTS formats, and newly-evolving SCOTS formats. NIMA will support appropriate national and commercial efforts to develop open exchange standards for metadata, raster, vector, text, voice, motion video, and web services. Development of open exchange standards is partially supported by the current program, but additional funding will be required through the *USIGS Geospatial Transition Plan*.

- **Foundation Data (FD) and Mission-Specific Data Set (MSDS) Data Content Specifications (5.2.1)**

  NIMA will complete Data Content Specifications (DCSs) for vector data FD components and develop the first comprehensive set of MSDS DCSs for air, land, urban, littoral, and ocean areas. These content specifications will be developed in conjunction with NIMA customers and define the required geospatial information, accuracy, density, and currency – based on intended uses.

The content of FD and MSDS described in these specifications will enable users, when accessing feature level databases in the future, to construct a wide variety of prescribed and tailored "views" of the mission space. DCSs will enable users to perform directed database searches to support their specific information needs and/or presentation requirements.

- **Presentation and Symbolization Specifications (5.2.2)**

  Along with DCSs, NIMA will develop presentation and symbolization specifications to define prescribed "views" of the mission space. For the transition to digital geospatial information to be successful, users must be able to select pre-defined "views" with the click of a button. An example of a prescribed view is presentation of geospatial information similar to the content and symbolization of a traditional map product. "Recipes" define the ingredients and processes required to generate a prescribed view. Ingredients include the content (e.g., features, elevation data, and imagery), marginalia information, and symbolization and presentation criteria.

  NIMA's Geospatial Symbology (GeoSym) is the current standard for symbolizing digital geospatial information. As DCSs are developed for FD and MSDS, GeoSym will be reviewed and updated to support evolving symbolization and presentation requirements. This will support not only pre-defined "views" but will also allow users to build new tailored "views" to meet changing mission needs.

Information Management

- **NIMA Geospatial Storage System and Digital Product Data Warehouse (6.1.1)**
  NIMA will expand the NGSS file management capabilities, storage capacity, and network access to give internal NIMA users access to selected foundation data and MSDS holdings – currently held as individual product files. The NGSS serves as a central repository accessible via NIMA's Intranets to support internal acquisition, production, and management for foundation-based operations. This system, coupled with the capabilities of the Digital Products Data Warehouse (DPDW), provides the file-based near-term solution for the NIMA geospatial library.

  New and updated foundation data files will automatically be posted from NGSS to the NIMA Gateway. This improves customer access to current NIMA imagery and geospatial information and reduces or eliminates labor-intensive manual file transfer processes currently in use.

- **Migration of Existing Digital Product Files into NGSS (6.1.2)**
  NIMA's current digital product files are stored across a wide array of data warehouses, tape libraries, production systems, and local workstations. NIMA will implement standard metadata for these files so appropriate files may be migrated to a consolidated file-based storage architecture as a follow-on to the NGSS and DPDW. Standard metadata will allow NIMA to catalog and manage geospatial information files. Metadata will also enhance discovery and retrieval of files from the consolidated file-based storage architecture and from the NIMA Gateway.

  Maintaining appropriate files in the consolidated file-based storage architecture not only facilitates NIMA's shift to acquisition and production of foundation data and MSDS, it also supports implementation of readiness assessment based on the "utility" of available geospatial information. This initiative is partially funded under NIMA's current program. Additional funding is required through the *USIGS Geospatial Transition Plan*.

- **Feature-Level Database (FLDB) Development (6.2.1)**
  As an interim step toward achieving an object-based data environment, NIMA will prototype and implement a COTS-based FLDB, a mid-term solution for the NIMA geospatial information library. For feature data the FLDB will store and manage point, line, and polygon features and their associated attributes based on a physical data model implementation of the UCDM. The FLDB will also store elevation information. The FLDB provides the basis for analyzing and conflating multiple instances of geospatial feature and attribute information. This is an important step in preparing existing geospatial information for migration into the target object-based environment of the NIIL. As part of the FLDB development, NIMA will establish interfaces between existing production systems and databases. This will support migration of legacy geospatial information into the logically-integrated, seamless FLDB. From this new library geospatial information can be extracted and generalized or intensified to meet requirements of NIMA customers. The FLDB is funded under NIMA's current program. However, additional funding is required in the *USIGS Geospatial Transition Plan* to accelerate development and implementation.

- **Data Authority Determination for Migration and Maintenance (6.2.2)**
  NIMA will use the UCDM/UEDM as the complete conceptual list of geospatial information entities that will be captured and maintained to support determination for migration into and maintenance of data within the Feature-Level Database (FLDB). To support the migration and maintenance of entities into the FLDB, NIMA and the Services will conduct a mapping of each entity to existing systems responsible for capturing and maintaining the data. Once the mapping is complete, the authoritative source for each entity will be decided. These authoritative sources will be used as part of the migration planning of existing data stores into the FLDB and ultimately to the NIIL. This process should significantly reduce or eliminate redundancy between databases and maximize efficiency in database population and maintenance.

- **One-Touch Maintenance Environment Prototype (6.3.1)**
  NIMA completed a prototype of the target architecture for the NIIL through the "Big Idea" initiative. The "Big Idea" tested concepts for NIMA's future database maintenance environment. It assessed the feasibility of achieving a collaborative "one touch" information maintenance environment with enhanced access and navigation to geospatial information. In the object-based environment of the NIIL, features will be stored one time and used to support a multitude of output representations and scales – from high-resolution MSDS to planning-level FD and more generalized, smaller-scale views. This design offers the potential to greatly reduce the cost of information maintenance. Geospatial information successfully migrated and integrated into the FLDB will become the primary source for loading the NIIL. Under the FLDB initiative, interfaces between the feature environment and architectures tested under the "Big Idea" initiative will be developed to prototype future loading of the NIIL.

- **Sustainment of Aeronautical Production Systems (6.4.1)**
  In the near-term and mid-term, NIMA will maintain the existing Aeronautical Migration System (AMS) software to support the collection, processing, management, and dissemination of safety of navigation information.

- **Migration of Aeronautical Production Databases to the FLDB or NIIL (6.4.2a)**
  Over the mid-term (FY04-05), NIMA will migrate the Aeronautical Digital Database Environment (ADDE) into the distributed architecture of the FLDB. The ADDE

supports the Automated Air Facilities Information File (AAFIF), Digital Aeronautical Flight Information File (DAFIF), and Flight Information Publication (FLIP) products. Vertical obstruction data (VOD) is currently produced and maintained in the text-based Digital Vertical Obstruction File (DVOF). NIMA will migrate DVOF into the FLDB environment. This will support conflation of VOD and aeronautical features with the geospatial information generated to populate FFD and MSDS. In the long-term, NIMA will migrate the aeronautical safety of navigation databases into the distributed architecture of the NIIL.

- **Upgrade AMS Workstations and Interface to the FLDB (6.4.2b)**
  NIMA will, along with the migration of the Aeronautical Digital Database Environment, upgrade legacy AMS workstations to improve the processing and finishing of aeronautical information.

- **Development of the FLIP Chart Production Environment (FCPE) (6.4.3a)**
  NIMA will develop the capability to extract FLIP Enroute Charts and Instrument Approach Procedures from the ADDE and follow-on FLDB environment. This FLIP Chart Production Environment (FCPE) will support Digital-to-Plate (DTP) printing and will make digital files available for web access.

- **Support New Format of Instrument Approach Procedures (6.4.3b)**
  Until the FCPE is fully implemented, NIMA will support manual production of Instrument Approach Procedures in the VOLPE format (developed by the VOLPE Center, part of the US Department of Transportation) as required to improve navigation safety. When the FCPE is fully operational, the VOLPE format will be supported through the digital-to-plate (DTP) printing process.

- **Digital Aeronautical Flight Information File (DAFIF) Updates (6.4.4)**
  NIMA will update the DAFIF structure/format every two years. This corresponds to the upgrade schedule of the DoD flight management and mission planning systems. NIMA will complete the updates to meet the required schedule.

- **DCAFE Sustainment to Support Digital Nautical Chart and Tactical Ocean Data (6.4.7a)**
  In the near-term, NIMA will support sustainment of Data Capture and Finishing Environment (DCAFE) workstations used in the production and maintenance of DNC and TOD. Over the mid-term, these workstations will be replaced by Integrated Exploitation Capability (IEC) workstations. Sustainment of DCAFE is partially funded in the current program, but additional funding is required as identified in the *USIGS Geospatial Transition Plan*.

- **Sustainment and Enhancement of the Specialized Production System (6.4.7b)**
  NIMA will sustain and upgrade systems that support classified Navy programs requiring specialized TOD (referred to as Chief of Naval Operations (CNO) Special Production).

- **TOD Software Development to Support TOD 3, 4, and 5 (6.4.7c)**
  NIMA will develop software to support additional types of TOD (TOD 3, 4, and 5) required to support deployment of the Navy's new attack submarine.

- **Sustain the Navigation Safety System (NSS) (6.4.7d)**
  NIMA will sustain the Navigation Safety System (NSS). Geospatial information generated by this nautical production system meets critical safety of navigation

requirements. Sustainment of NSS is partially supported in the current program, but additional funding is required as identified in the *USIGS Geospatial Transition Plan*.

- **Sustain Hydrographic Source Assessment System (HYSAS) (6.4.7e)**
  NIMA will sustain the Hydrographic Source Assessment System (HYSAS). Geospatial information generated by this nautical production system meets critical safety of navigation requirements.

- **Near-Term Development and Sustainment of the HydroVision NIMA Production Cell (6.4.8a)**
  Near-term, NIMA will continue insertion of object-oriented technology into the HydroVision NIMA Production Cell (NPC). The development is a precursor to the Nautical Database Maintenance Environment (NDME) that will serve as an operational model for the longer-term development of the NIMA Integrated Information Library (NIIL). Development and sustainment of the HydroVision NPC is partially funded in NIMA's current program. Additional funding is required through the *USIGS Geospatial Transition Plan*.

- **Sustainment and Migration of the Geospatial Sciences Center (GSC) Production Systems (6.4.12)**
  In the near-term NIMA will sustain the existing GSC production systems. In the mid-term NIMA will plan for their migration into the distributed architecture of the FLDB. GSC production workstations will be upgraded through the Integrated Exploitation Capability (IEC) workstation program.

Information Acquisition/Production – Maintenance Strategy

- **Prototype and Implement Automated Processing for Geospatial Information Generation (7.1.1)**
  NIMA will prototype automated production of selected geospatial information to leverage advances in imagery and multi-sensor processing. Candidates include:
  - Reflective-surface digital elevation models (DEMs),
  - orthophotos and Controlled Image Base (CIB),
  - triangulation and geopositioning,
  - targeting support and Digital Point Positioning Data Bases (DPPDBs),
  - change detection, and
  - automated extraction of selected features such as Vertical Obstruction Data (VOD).

  Selected capabilities will be prototyped under NIMA's current program. Others will be prototyped through funding identified in the *USIGS Geospatial Transition Plan*.

- **Acquisition/Production Strategy (7.2.1)**
  NIMA will transition away from standard products generated on legacy standalone production systems. NIMA will shift resources to implement and expand foundation-based operations to support global readiness. Readiness will measured as a function of foundation data availability, timelines to respond to a potential crisis, and NIMA's capability and capacity to satisfy the resulting requirements. NIMA will develop, execute, and continually refine a data acquisition and production strategy that will leverage data from alternative sources and establish new information acquisition

methods. NIMA will develop and execute a process for evaluating data quality to ensure accuracy, currency, content, and density meet customers' requirements. NIMA will emphasize acquisition of commodity geospatial information from vendors who also have a maintenance commitment for the data. NIMA will support implementation of tools for assessing, cataloging, acquiring, and integrating data from alternative sources. NIMA will also assess the knowledge, skills, and abilities required for information acquisition and integration.

- **Maintenance Strategy (7.2.2)**
  The current maintenance strategy employs product reviews that recommend maintenance actions based on an evaluation of probable obsolescence of geospatial information. NIMA will develop and implement a strategy that takes advantage of change detection analysis to initiate maintenance actions for land-based information. NIMA will establish regional priorities and currency requirements to determine whether areas of detected change warrant a maintenance action for information held based on accuracy, currency, content, and density as defined by customer requirements.

Information Acquisition/Production – Safety of Navigation

- **Digital Nautical Chart (DNC) and Tactical Ocean Data (TOD0 Production and Maintenance (7.3.1a)**
  NIMA will support hydrographic chart production and maintenance for information that has been digitized under the DNC program by updating and maintaining this new database with safety of navigation information. This digitization effort is to meet Navy operational requirements for support to two carrier battle groups (CVBG) by 2002 and a fully digital bridge on all Navy vessels by 2004.

- **Tactical Ocean Data Maintenance (7.3.1b)**
  NIMA will outsource production of TOD to achieve full maintenance by 2004. This is the target date for Navy's operational transition to an "all-digital" bridge. TOD is required in conjunction with the DNC to support deployment of the Virginia Class submarine.

- **Airfield Surveys – Global Positioning System (GPS) Surveys (7.3.7a)**
  NIMA will collect airfield data using the Global Positioning System (GPS) to achieve accurate survey positions. This data will be used to design GPS airfield terminal approach procedures. Surveys are partially supported under the current program, but additional funding is needed under the *USIGS Geospatial Transition Plan*. Outsourcing is required to meet NIMA's commitment to complete the collection program and support five-year updates.

Information Acquisition/Production – Foundation Data

- **Foundation Feature Data (FFD) (7.4.1)**
  An analysis of the near-global requirement for FFD provides the potential for a new acquisition/production approach. This approach does not change the total requirement to achieve 19,200 cells of coverage, as represented in the Imagery and Geospatial Requirements Document (IGCRD). Instead, it proposes to provide FFD coverage over all medium-priority and high-priority areas by 2010 and delay completion of the total coverage requirement to beyond 2010. NIMA will achieve this coverage by:

- maintaining a core NIMA workforce capability for FFD production (these personnel will also be available to support NIMA's core workforce crisis response capability as required),
- developing coproduction partnerships with the national and international community,
- exploiting alternative sources of geospatial information, such as commodity data, and
- increasing the outsourcing program for FFD to make up the shortfall.

These initiatives are supported in the current program, but additional funding is required as identified in the *Geospatial Transition Plan* to acquire commodity data and significantly increase the FFD outsourcing program to achieve coverage over an area of 10,700 cells by 2010.

♦ **Controlled Image Base (CIB) (7.4.5)**

The total requirement for Controlled Image Base (CIB) coverage as represented in the IGCRD is 19,200 cells by FY05. NIMA's current program will achieve coverage of approximately 14,900 cells by FY05. Through the funding identified in the *USIGS Geospatial Transition Plan*, NIMA will employ additional contractor support to complete near-global CIB coverage (19,200 cells) by the end of 2005.

♦ **Digital Point Positioning Database (DPPDB) (7.4.6)**

The Digital Point Positioning Database (DPPDB) program also has a shortfall in available resources for outsourcing. NIMA's current program will complete approximately 6,100 cells of coverage by the end of FY07. Through the funding identified in the *USIGS Geospatial Transition Plan*, NIMA will address requirements in the IGCRD to accelerate the program and complete DPPDB coverage of approximately 7,100 cells by the end of FY05.

♦ **Geopositioning Program (7.4.7)**

The need to provide geopositioning to support contract production and internal requirements for FFD, CIB, and DPPDB has generated a backlog in this program. The resulting shortfall in geopositioning data prevents NIMA from accomplishing other acquisition and production programs. In-house resources are insufficient to work off the backlog. NIMA will provide additional contractor support for geopositioning to eliminate the current backlog.

♦ **Gravity and Gravity Gradiometry Data (7.4.8)**

Existing gravity and gravity gradiometry holdings contain both areas of poor data quality and areas of no data. Gravity and gravity gradiometry data are critical to inertial navigation systems as well as to smart weapon systems that require the data for navigation and targeting. This data collection shortfall is partially funded in NIMA's current program, but additional funding is required as identified in the *USIGS Geospatial Transition Plan*.

♦ **Satellite Geodesy (7.4.9)**

NIMA will continue to support near-real-time navigation and post-analysis of precise navigation systems that use WGS-84. This effort is funded in NIMA's current program, but additional funding is identified in the *USIGS Geospatial Transition Plan* to account for the increased cost of ephemeris post-processing and for maintaining worldwide tracking stations.

Information Acquisition/Production – Mission-Specific Data Sets (MSDS)

- **NIMA's Core Workforce for the 'Readiness and Responsiveness' Strategy (7.5.1)**
  In the event of a crisis NIMA will provide a core workforce to execute the "responsiveness" strategy. When not engaged in a crisis, this workforce will fulfill prioritized requirements for MSDS development and other prioritized needs for geospatial information.

Information Acquisition/Production – Analytical Services

- **Forward Deployed Support (7.6.1)**
  NIMA will continue to provide Liaison Officers, Technical Representatives, Crisis Support Response Teams (CSRT), and Contingency Response Teams (CRTs) to Commands, Services, and Agencies based on available resources. The Liaison Officers represent the Director, NIMA and assist customers in the development of doctrine, training, force structure, and system design issues related to imagery and geospatial information. NIMA will deploy technical representatives to customer sites with modern geographic information system (GIS) workstations. They have the skills to satisfy many immediate mission information needs using available geospatial data.

  NIMA will deploy CSRTs worldwide to support crisis operations. These may include disaster relief efforts, humanitarian assistance, military operations, or other contingencies. CSRTs deploy for the duration of the mission to augment customer staffs with a combination of skills including end-to-end imagery tasking and exploitation, geospatial information analysis, and computer system operation. NIMA will deploy CRTs to support National Intelligence Support Teams (NISTs). CRTs are composed of geospatial or imagery analysts who are trained and equipped to deploy worldwide. Once deployed, they become full members of the NIST.

- **Reach-Back Support (7.6.2)**
  In addition to the delivery of foundation data (including safety of navigation information) and MSDS through NIMA's "readiness and responsiveness" strategy, NIMA will maintain a capability to deliver geospatial analytical services in response to specialized information needs. NIMA's geospatial analytical services will provide "reach-back" support for:
  - NIMA's technical representatives, CSRTs, and CRTs,
  - Organic geospatial assets of Commands, Services, and Agencies – such as the topographic units in the Army and Marine Corps, and
  - Commands, Services, and Agencies with limited or no organic geospatial assets.

Exploitation Capabilities

- **Integrated Exploitation Capability (IEC) Workstations (8.1)**
  NIMA will migrate from a variety of legacy workstations to an Integrated Exploitation Capability (IEC) workstation based on COTS hardware and software. The IEC workstations will reduce O&M costs and will facilitate technology insertion through routine upgrades of COTS applications software. IEC workstations will be phased in over the POM period to provide enhanced capabilities for the NIMA workforce. As IEC workstations replace legacy production systems, they will be used to facilitate migration

of NIMA data into the FLDB and eventually into the NIIL. NIMA will implement IEC workstations into maritime safety of navigation, hydrographic, and geodesy/geophysical production systems to address the unique data processing and information finishing needs of those programs. NIMA will ensure that the IEC implementation is coordinated with other initiatives such as the Nautical Data Maintenance Environment (NDME) that provide enhanced capabilities to achieve the future integrated information environment. The IEC workstation program is funded under NIMA's current program. However, additional funding is required in the *USIGS Geospatial Transition Plan* to accelerate replacement of legacy workstations.

- **Integrate Enhanced Software Applications into Operational Systems to Upgrade the Processing of Spectral and Radar Imagery (8.3b)**
  NIMA supports research and development activities to identify and develop a variety of new exploitation tools and sources. Through this initiative NIMA will integrate enhanced software applications to enhance processing of multispectral, hyperspectral, ultraspectral, and radar imagery sources. Technology insertion will be based on successful testing and demonstration of potential operational capabilities from NIMA's research and development program.

Customer Information Access, Discovery, and Retrieval

- **Customer Access to Existing NIMA Holdings via the Gateway (9.1.1a)**
  NIMA will load geospatial information from a variety of standalone data stores onto the Gateway to provide a single integrated access point for NIMA customers. This includes critical foundation data such as Digital Point Positioning DataBases. A significant amount of new geospatial information is expected to become available soon and NIMA will make this available via the Gateway. Examples include the near-global Land Use/Land Cover database, SRTM data, and the Commercial Satellite Imagery Library. From a NIMA customer's perspective, the Gateway will serve as the "one-stop" shopping location for NIMA's information holdings. This initiative is partially supported by the current program, but additional funding is required as identified in the *USIGS Geospatial Transition Plan*.

- **Value Adding (9.1.4)**
  In addition to producing content itself and acquiring it from other providers, NIMA will accept external or customer-contributed information and knowledge into its holdings. NIMA will provide a capability for approved organizations to send value-added geospatial information that has been collected and/or produced locally to the Gateway. This value-added data will be available for inclusion as "qualified data," or will be used by NIMA personnel as source for integration into the trusted geospatial information framework. Intelligence and operational customers will work with NIMA to develop and implement tactics, techniques, and procedures to define what information should be value-added and how it will be validated for submission to the NIMA Gateway. This initiative is partially supported by the current program. Additional funding is required as indicated in the *USIGS Geospatial Transition Plan*.

- **VPF Database Update (VDU) Capability (9.3.2a)**
  NIMA will implement a VPF Database Update (VDU) capability for the Digital Nautical Chart (DNC) VPF file to provide for update and integration of critical safety of navigation information. The VDU will allow NIMA to disseminate new or changed data that becomes available in an area after publishing and disseminating the base VPF file.

The VDU will significantly reduce communications requirements for dissemination of navigation safety updates to DNC, and will meet operational requirements to support the Navy's "digital bridge."

- **Downstream Storage via Command Information Libraries (CIL) and Image Product Libraries (IPL) (9.3.3)**
  NIMA's strategy is to establish a single software baseline for all NIMA libraries for consistent functionality, reduced operations and maintenance costs, and greater flexibility. This strategy will address the capabilities of libraries to store and support discovery of imagery and geospatial information in the Command Information Libraries (CIL) and Image Product Libraries (IPL), as well as intelligence products within the CIL. This effort will replace and expand upon the data storage and delivery capabilities of the existing IDEX II system.

- **Remote Replication System (RRS) (9.3.4)**
  The Remote Replication System (RRS) is a suite of COTS hardware and software that provides timely crisis and routine operational support to the warfighter. RRS creates tailored products (paper maps, charts, and digital products) from hardcopy and/or digital sources. The RRS provides limited replication capability for hardcopy output of digital information at forward-deployed user sites. NIMA currently owns, operates, and provides O&M for the RRS at nine sites with plans to expand the availability of the RRS in the user community. NIMA acquired four Modular Remote Replication System (MRRS) for the Navy/Marine Corps, two for use on the East Coast and two for use on the West Coast. A fifth MRRS was purchased by NAVSEA. Personnel manning these systems are defined in the memorandum of agreement (MOA) established between the customer and NIMA at the time the system is fielded.

  NIMA will continue to fund maintenance of the five MRRS systems deployed to the Navy/Marine Corps. NIMA plans for recapitalization of these systems in the mid- to long-term. For the near-term, NIMA will sustain the Remote Replication Systems (RRS) deployed with the CINCs and Services. Longer-term, NIMA will provide COTS replacements for RRS.

- **DLA On-Demand Production Services (9.3.5)**
  DLA Document Automation and Production Services (DAPS) is responsible for providing printing support for DoD, and it performs this mission at 270 locations worldwide. Currently, DAPS is working to support DLA's transition from paper-based business processes to on-demand electronic document processing. DLA plans to prototype the on-demand production services for geospatial information on paper, CD-ROM, and DVD in the European and Pacific Theaters. In coordination with NIMA on the development of distribution services, DLA intends to:
  - assess technology to determine the capability to support on-demand services;
  - analyze and compare traditional production costs for paper, CD-ROM, and DVD versus on-demand services for those media,
  - establish a pilot on-demand production capability for the European and Pacific Theaters,
  - implement electronic ordering processes and procedures and a geospatial interface, and
  - investigate integration of ordering procedures for on-demand services with the Global Combat Support System (GCSS).

End-User Tools and Services

- **Commercialization of the Joint Mapping Toolkit (JMTK) (10.1)**
  The Joint Mapping Toolkit (JMTK) is a toolkit containing application programmer interfaces within the Defense Information Infrastructure/Common Operating Environment (DII/COE). It provides the functions necessary to render a common view of the battlespace by standardizing the import, manipulation, and display of digital geospatial information. A commercialized JMTK will ultimately replace the existing mapping functions for DII/COE Mission Applications. The commercialized version of the JMTK will be designed around a modular configuration to allow customers to tailor their visualization requirements, selecting only the modules necessary to accomplish their mission. NIMA will fund the development and maintenance of a best-value commercial replacement for JMTK and will provide lifecycle support for this replacement to include enterprise licenses, technical support, certification and testing, distribution, training, and government-driven enhancements. The lifecycle support will be provided at no cost to DII/COE users.

  JMTK provides a collection of services that constitute the core mapping requirements within the Global Command and Control System (GCCS) and related DoD command and control systems. JMTK is the joint responsibility of the Defense Information Systems Agency and NIMA. Actual implementation of the commercial-based JMTK capabilities within GCCS is planned for FY04. This initiative also addresses the JMTK functionality with the Services' GCCS structure (ie.g., the GCCS-M and GCCS-A). Commercialization of JMTK is funded under the current program, however, additional funding is needed as indicated in the *USIGS Geospatial Transition Plan* to accelerate the schedule.

- **Geospatial Technology Assessment (10.3)**
  Growing user requirements for geospatial capabilities and the variety of available commercial geographic information system (GIS) technologies require an organized method of identification and assessment. NIMA will focus the Pathfinder evaluation of needs on those requirements submitted by USIGS through the Dynamic Object Oriented Requirements System (DOORS) process. NIMA will identify, assess, and publish its findings on tools and technologies to better exploit increasing amounts of geospatial information to serve an expanding customer base. NIMA will also consolidate and coordinate the purchase of community licenses for products that have potentially wide application. License consolidation will save costs through consolidated acquisition, rather than having each organization in the community procure individual or organizational licenses independently. NIMA will also expand its technology program to assess the ability of commercial geospatial applications to not only meet functional requirements as standalone products but also to meet systems and technical architecture requirements. The goal will be to rapidly insert and integrate SCOTS applications into formal acquisition programs of USIGS organizations whenever feasible.

- **Software Clearinghouse (10.4)**
  NIMA will develop a clearinghouse for GOTS image processing and geospatial applications for dissemination via the Gateway. The clearinghouse will also disseminate COTS and SCOTS applications and any associated updates for which USIGS organizations have purchased a large number of licenses.

The clearinghouse will also collect and make available for dissemination useful extensions to widely-used GOTS, COTS, and SCOTS applications. Availability of any individual software component from the clearinghouse will not imply NIMA certification (e.g., for accuracy or functionality), since software certification would require additional NIMA funding.

Education and Training

- **Community Geospatial Information Training Council (CGITC) (11.1)**
  The National Imagery and Mapping College (NIMC) is responsible for integrated training to meet the career-based needs of NIMA employees and for both providing and overseeing imagery and geospatial information training for members of USIGS. The NIMC has established an integrated Professional Education and Training Program and will develop and maintain a system to review and coordinate activities associated with the presentation of imagery and geospatial information training by NIMA and other US Government Departments and agencies to the USIGS and foreign nationals. NIMA will establish a USIGS Community Geospatial Information Training Council (CGITC) to evaluate and assess training needs. The forum will:
  - identify a standardized core curriculum to satisfy geospatial training needs,
  - promote an awareness of and appreciation for the need of USIGS geospatial training,
  - ensure training requirements associated with implementation of new systems, capabilities, and standards are integrated into training plans,
  - promote academic, commercial, and interagency partnerships to satisfy geospatial training needs,
  - consolidate purchases of licenses for distance learning through commercial suppliers, and
  - evaluate geospatial innovations for their utility within the USIGS.

- **Geospatial Analyst Development for the NIMA Workforce (11.2a and 11.2b)**
  As NIMA migrates to a digital environment, the USIGS will require training in geospatial analysis to fully support both military leadership and national decision makers with a broad spectrum of geospatial information. To support DoD requirements, each Service must address the level of leader and technical training required for their occupational fields. The NIMA College will develop and train intermediate and advanced course work in collaboration with USIGS organizations to meet these complex mission requirements. Coursework will incorporate real-world data discovery, access, production, and exploitation in a simulated operational environment. Coursework funded under NIMA's current program includes:
  - Basic and Advanced Military Occupational Specialty (MOS) qualification training in geospatial-related fields,
  - Geospatial Analyst training to develop a USIGS-wide ability to access, retrieve, evaluate, integrate, analyze, and exploit available geospatial information,
  - basic and advanced remotely sensed imagery and geographic information systems courses to familiarize geospatial analysts with concepts, theories, principles, and applications,

- geospatial fundamentals to understand and exploit geospatial concepts, systems, processes, and procedures within the broad range of USIGS leadership and technical skills,
- military leadership and national decision-maker training on the capabilities of geospatial information and its usefulness in strategic, operational, and tactical decisions,
- expansion of training through the use of alternate delivery methods such as computer based training/web-based training, video teleconferencing, and mobile training teams,
- training of Marine Analysts to enhance Digital Nautical Chart maintenance and safety of navigation production through the use of imagery,
- provision of expanded multi-faceted regional awareness training to allow for sophisticated, comprehensive analysis,
- assistance to the Intelligence Community in incorporating geospatial concepts throughout all phases of intelligence training to facilitate the fusion of imagery, imagery intelligence, and geospatial information, and
- assistance in the widespread implementation of fundamental geospatial education throughout existing military, national, and international training institutions.

♦ **Foundation-Based Operations Training (11.3)**

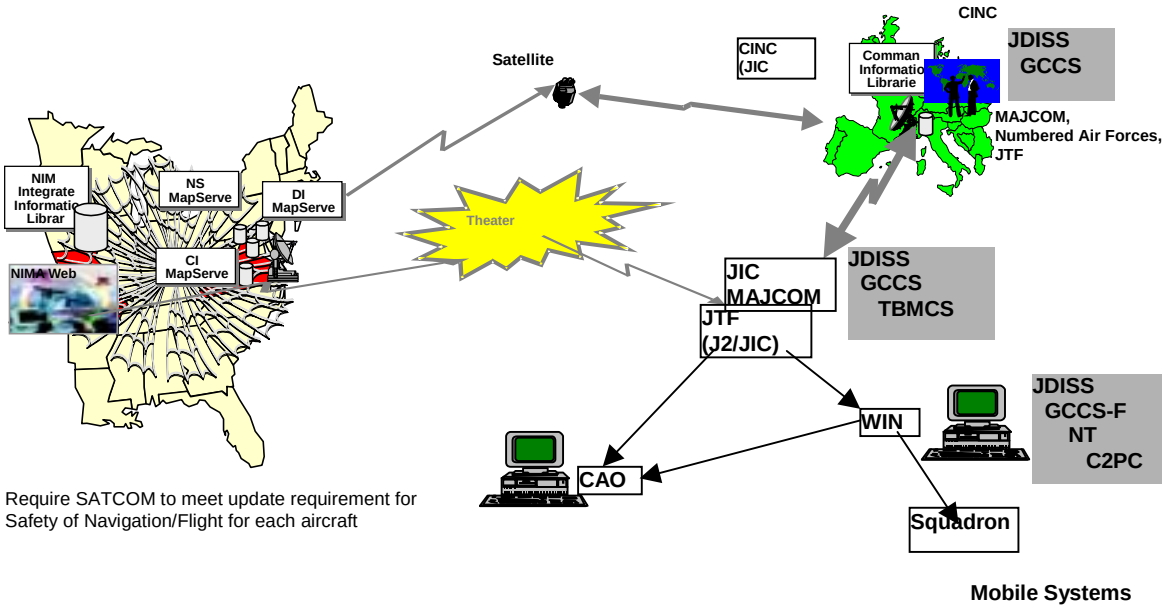
The NIMA College will implement training to develop the knowledge, skills, and aptitudes needed to operate in a USIGS geospatial information environment. Revolutionary change is needed to move from production and maintenance of legacy hardcopy products to population and continuous maintenance of a geospatial database from which information and views of the data can be derived. The NIMA College has reprogrammed its budget to substantially increase the investment in geospatial training (and/or retraining) for the NIMA workforce, co-producers, and unified data producers in the concepts, principles, processes, and content associated with foundation-based operations. The NIMA College is working to deliver the training identified below; however, assistance will be required from other NIMA directorates in the form of rotational and adjunct faculty and subject matter-experts for full implementation:

- foundation data and mission-specific data set creation to populate and maintain the FLDB/NIIL and derive desired information and views from the data,
- advanced sensors to fully understand their capabilities and limitations for the purposes of exploitation,
- the USIGS Conceptual Data Model to fully understand standard geospatial terminology and ensure interoperability across systems and software applications as well as future web based applications using Geography Markup Language (GML),
- data evaluation, quality control, and quality assurance of NIMA-produced geospatial data as well as that of NIMA contractors, international partners, unified data producers, and commercial suppliers,
- production systems, concepts, procedures, maintenance, and tools,
- development of standardized lessons (as determined by the CGITC) for insertion into Service staff and leadership training, and

- establishment of fundamental knowledge management for internal NIMA and external managers.

Appendix B: Service Operational Concepts

Air Force Operational Concept

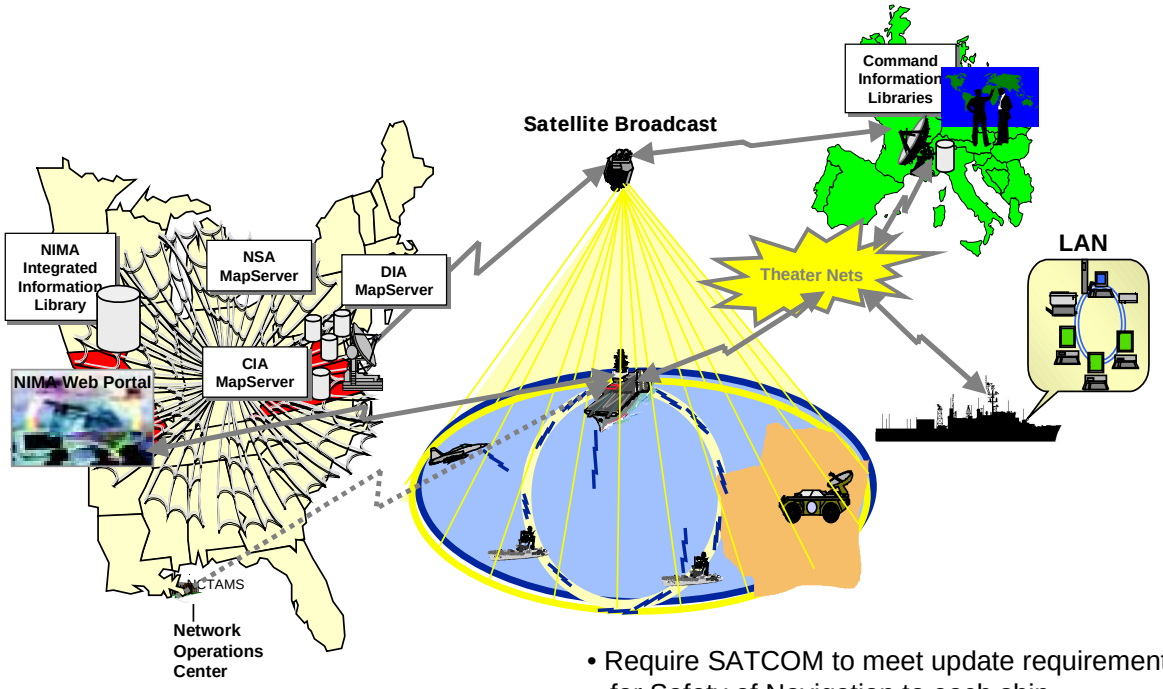


The objective is to provide an infrastructure that will allow customers of geospatial support to collect, query, access, receive, process, integrate, exploit, intensify, analyze, produce, disseminate, store, manage, validate, and visualize all-source geospatial information and geographic intelligence for all mission areas.

The Air Force is establishing a process and direction to ensure geospatial information needs of the warfighter are met to establish and maintain air superiority and information dominance in the 21st century. This includes defining the necessary strategy for establishment of a geospatial information infrastructure (GII) that will support employment of geospatial information for digital mapping display, analysis, mission planning, and visualization of the battlespace.

CINCs will be responsible for setting up and administering a “primary” server that will support any activity within their Area of Responsibility (AOR). Air Force MAJCOMs and NAFs will have secondary geospatial servers, which will provide up-to-date geospatial information to support the CAOC, Wings, and Squadrons. At this time there is no planned geospatial server/architecture connection to support coalition forces or a coalition network.

Navy Operational Concept



• Require SATCOM to meet update requirement for Safety of Navigation to each ship

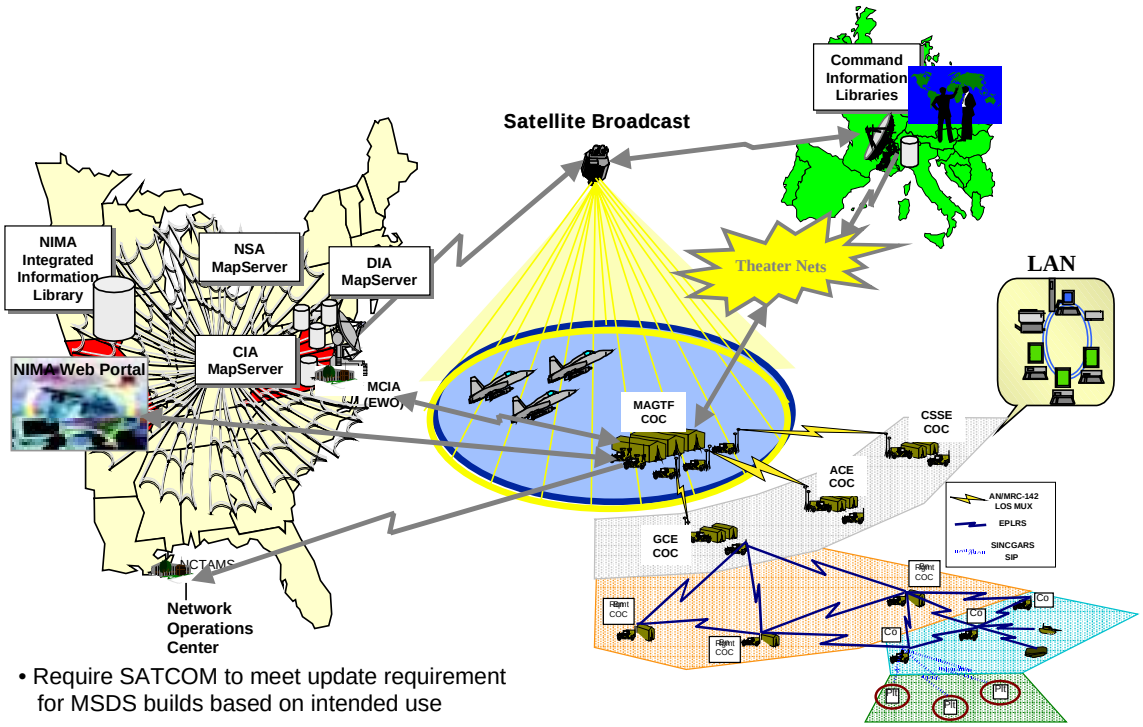
The objective is to provide integration of geospatial information and imagery to support production of geographic intelligence for naval commanders. The geospatial information infrastructure will support production of digital products, disseminated electronically throughout the naval communication network, as well as provide low-volume replication of tailored hardcopy views.

The Navy's future infrastructure will include advanced geographic information systems and libraries, employing commercial and non-developmental item hardware and software to provide the framework for a CROP.

The geospatial information infrastructure will be a network of systems that allows each commander to exercise near-real-time control, coordination, and direction of naval geospatial and geographic intelligence production operations. The extent of support functions provided by the geospatial information infrastructure will correspond to the size and capability of the ship (and fixed facilities) at which the systems are employed, as well as mission requirements. The geospatial information infrastructure will accomplish its mission through performance of the following major functions:

- Provide for receipt, storage, and retrieval of all-source geospatial information and geographic intelligence data.
- Provide an environment for geospatial information and geographic intelligence queries through a "push/pull" capability.
- Facilitate display, processing, reporting, and dissemination of geospatial information and geographic intelligence.
- Provide geospatial information and services software applications for collection, query, access, processing, integration, exploitation, intensification, analysis, production, dissemination, storage, management, validation, visualization, and utilization of geospatial information and geographic intelligence.

Marine Corps Operational Concept



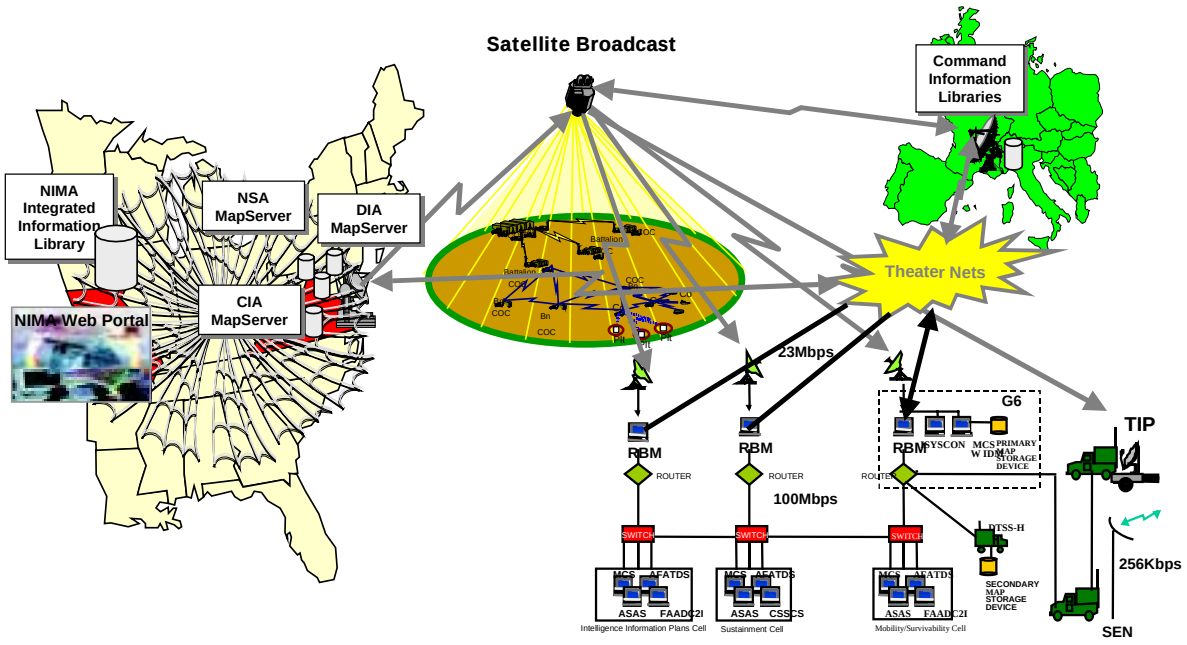
• Require SATCOM to meet update requirement for MSDS builds based on intended use

The objective is to provide as an integrated, deconflicted, seamless geospatial information database as the framework for visualization and analysis of the combined arms battlespace.

The Marine Corps geospatial information infrastructure will provide an accessible data store in the Tactical Geospatial Information Library (TGIL) linked to various levels of the Marine air-ground task force (MAGTF) so they can query and receive geospatial information (GI) and geographic intelligence (GEOINT).

- The Topographic Platoon, in conjunction with and supported by the Marine Corps Intelligence Activity (MCIA) Geospatial Division, provides all levels of the MAGTF with an integrated, intensified, deconflicted, and seamless GI and GEOINT framework.
- This capability allows development and sustainment of a common, near-real-time, integrated framework to support situational awareness of the battlespace. This information will be detailed enough to support tactical analysis, serve as the frame of reference for fusion of information from other domains (i.e., environmental, logistical, operational, intelligence, and diplomatic) and support updates and modifications to meet the mission-specific requirements of a fluid battlespace.
- Within a theater of operation, the Topographic Platoon will be capable of providing three different methods for GI and GEOINT dissemination using the MAGTF Communication Information Services (CIS) Network, electronic media, and hardcopy media.
- Connectivity to NIMA will employ all existing communication media (e.g., satellite, single and multi-channel radio, wire, fiber optic cable, Local Area Networks (LANs), Wide Area Networks (WANs), switching system (circuit/voice) and automated network and nodal control, all of which form a MAGTF-wide information grid in the C4I architecture).

Army Operational Concept



- Require SATCOM to meet update requirement for MSDS builds based on intended use

The objective is to disseminate Digital Geospatial Data to Army command and control systems, warfighting platforms, and soldiers at all echelons to achieve battlespace visualization.

Digital Geospatial Data will be provided to commanders, staffs, weapon platforms, and soldiers in a seamlessly integrated fashion that is tailored to assigned missions.

Dissemination of geospatial data sets will be accomplished in three stages:

1. Initial – Multiple national agencies provide the initial data sets.
2. Update – received from national agencies and in-theater assets
3. Feedback – Scouts and reconnaissance units provide value-added terrain data via a feedback loop. The tactical 'hub' of this dissemination, data management, and analysis is the Digital Topographic Support System (DTSS).
    - The DTSS is the tool used by the topographic engineer unit supporting commands from Theater to Maneuver Brigade.
    - The DTSS creates a common topographic operating environment (CTOE) for the ABCS, weapons platforms, and land warriors being supported.

The major components of the Digital Geospatial Dissemination Concept consist of: data availability from NIMA (includes foundation data, mission-specific data sets, and access to legacy data), communications availability (includes SATCOM, GBS, MSE, NTDR, JTR, etc.), availability of shared storage devices at all levels of command, and editing stations that provide tailored geospatial data sets for weapons platforms.

Appendix C: Glossary

Abbreviations and Acronyms

3D	three-dimensional
4D	four-dimensional
AAFIF™	Automated Air Facilities Information File™
ABCS	Army Battle Command System
ACE	Air Command Element (NATO)
ACE	Airborne Command Element (USAF)
ACTD	Advanced Concept Technology Demonstration
ADDE	Aeronautical Digital Data Environment
AFATDS	Advanced Field Artillery Tactical Data System
AFE	automated feature extraction
AICD	Application Interface Control Document
AIXM	Aeronautical Information Exchange Model
AMS	Aeronautical Migration System
AOC	Air Operations Center
API	application program interface
ASAS	All Source Analysis System
ASD(C3I)	Assistant Secretary of Defense for Command, Control, Communications, and Intelligence
BDA	battle damage assessment
BN	battalion
C	Confidential
C4I	command, control, communications, computers, and intelligence
C4ISR	command, control, communications, computers, intelligence, surveillance, and reconnaissance
CDA	Congressionally Directed Action
CD-ROM	compact disk – read-only memory
CGPC	Common Geospatial Processing Capability (ACTD)
CGITC	Community Geospatial Information Training Council
CHUM	Chart Update Manual
CIA	Central Intelligence Agency
CIB®	Controlled Image Base® (NIMA Trademarked)
CIB-5	5-meter Controlled Image Base
CIL	Command Information Library
CINC	Commander-in-Chief
CIO	Chief Information Officer
CIS	Communication Information Services
CJCSI	Chairman of the Joint Chiefs of Staff Instruction

CNO	Chief of Naval Operations
Co	company
COC	combat operations center
COE	Common Operating Environment
CONOPS	concept of operations
CONPLAN	concept plan
CONUS	continental United States
COP	common operational picture
COTS	commercial-off-the-shelf
CRADA	cooperative research and development agreement
CRDB	Control / Releasability Database
CROP	common relevant operational picture
CRT	Contingency Response Team (NIMA)
C/S/A	CINCs / Services / Agencies
CSRT	Customer Support Response Team (NIMA)
CSSCS	Combat Service Support Control System
CSSE	Combat Service Support Element
CTOE	Common Topographic Operating Environment (Army)
CVBG	Carrier Battle Group
DAFIF®	Digital Aeronautical Flight Information File® (NIMA Trademarked)
DAPS	Document Automation and Production Services
DB	database or data base
DCAFE	Data Capture and Finishing Environment
DCI	Director of Central Intelligence
DCS	data content specification
DEM	digital elevation model
DIA	Defense Intelligence Agency
DII	Defense Information Infrastructure
DLA	Defense Logistics Agency
DNC®	Digital Nautical Chart® (NIMA Trademarked)
DoD	Department of Defense
DOORS	Dynamic Object Oriented Requirements System
DPDW	Digital Products Data Warehouse (NIMA)
DPPDB	Digital Point Positioning Data Base
DTED®	Digital Terrain Elevation Data® (NIMA Trademarked)
DTOP	Digital Topographic Data
DTP	digital-to-plate
DTSS	Digital Topographic Support System
DVD	Digital Versatile Disk
DVOF	Digital Vertical Obstruction File
ECDIS-N	Electronic Chart Display and Information System - Navy

EGM96	Earth Gravitational Model 1996
ENC	electronic navigation chart
EPPIC	Enhanced Precise Positioning Integrated Capability
F2T2EA	finding/fixing/tracking/targeting/engaging/assessing
FAADC2I	Forward Area Air Defense Command Control and Intelligence System
FACC	Feature Attribute Coding Catalog
FAQ	frequently-asked question(s)
FBI	Federal Bureau of Investigation
FCPE	FLIP Chart Production Environment
FD	foundation data
FFD	Foundation Feature Data
FGDC	Federal Geographic Data Committee
FIA	Future Imagery Architecture
FLDB	Feature-Level Database
FLIP	Flight Information Publication
FLOT	forward line of troops
FMG	USIGS Functional Manager's Guidance
FOC	full operational capability
FOUO	For Official Use Only
FY	fiscal year
G6	Communications Staff Element of an Army (Division or higher) or USMC (Brigade or higher) Staff
GA	geospatial analyst (NIMA)
GBS	Global Broadcast Service
GCCS	Global Command and Control System
GCCS-A	Global Command and Control System – Army
GCCS-M	Global Command and Control System - Maritime
GCE	Ground Combat Element
GCSS	Global Combat Support System
GEOINT	geographic intelligence (Marine Corps)
GEOSym	Geospatial Symbology (NIMA)
G&G	geodesy and geophysics
GI	geospatial information
GII	Geospatial Information Infrastructure
GIS	geographic information system
GML	Geography Markup Language
GOTS	government off-the-shelf
GPS	Global Positioning System
GSC	Geospatial Sciences Center
GSMC	Geospatial Standards Management Committee
GTP	USIGS Geospatial Transition Plan

HDBT	hard and deeply buried target(s)
HYSAS	Hydrographic Source Assessment System
I3	Integrated Imagery and Intelligence
IA	imagery analyst
IC	Intelligence Community
IC GeoNet	Intelligence Community Geography Network
IC-MAP	Intelligence Community Multi-Intelligence Acquisition Program
IEC	Integrated Exploitation Capability
IGCRD	USIGS Imagery and Geospatial Capstone Requirements Document
IHO	International Hydrographic Organization
IMCON	Controlled Imagery
INS	inertial navigation system
INT	intelligence
IOC	initial operational capability
IPB	Intelligence Preparation of the Battlefield
IPL	Image Product Library
IPOM	Intelligence Program Objective Memorandum
ISMC	Imagery Standards Management Committee
ISO	International Organization for Standardization
ISO / TC211	Technical Committee 211, Geographic Information/Geometics, of the ISO
ISR	intelligence, surveillance, and reconnaissance
J2	Joint Staff Intelligence Directorate
JAVA	Just Another Vague Acronym
JCS	Joint Chiefs of Staff
JIGI	JSTARS Imagery Geolocation Improvement
JMRR	Joint Monthly Readiness Review
JMTK	Joint Mapping Toolkit
JSTARS	Joint Surveillance Target Attack Radar System
JTA	Joint Technical Architecture
JTR	Joint Tactical Radio
JV 2010	Joint Vision 2010
JV 2020	Joint Vision 2020
JWICS	Joint Worldwide Intelligence Communications System
Kbps	kilobits per second
LAN	local area network
LDM	logical data model
LIDAR	light detection and ranging
LIMDIS	Limited Distribution
LWD	Littoral Warfare Data
MAGTF	Marine Air-Ground Task Force
MAJCOM	major command

Mbps	megabits per second
MCIA	Marine Corps Intelligence Activity
MCS	Maneuver Control System
MDDS	Multi-information Domain Dissemination Service
MOS	Military Occupational Specialty
MOUT	military operations in urbanized terrain
MSDS	mission-specific data set(s)
MSE	Mobile Subscriber Equipment
MTI	moving target indicator
multi-INT	multi-intelligence
NAF	numbered Air Force
NATO	North Atlantic Treaty Organization
NDME	Nautical Database Maintenance Environment
NEO	noncombatant evacuation operation
NGSS	NIMA Geospatial Storage System
NIC	National Intelligence Council
NIIL	NIMA Integrated Information Library
NIMA	National Imagery and Mapping Agency
NIMC	National Imagery and Mapping College
NIPRNET	Non-Secure Internet Protocol Router Network
NIST	National Intelligence Support Team
NOE	nap-of-the-earth
NOFORN	No Foreign
NPC	NIMA Production Cell
NRO	National Reconnaissance Office
NSA	National Security Agency
NSS	Navigation Safety System
NTM	national technical means
O&M	operations and maintenance
OPLAN	operations plan
OPR	office of primary responsibility
OPSEC	operational security
ORD	Operational Requirements Document
OSIS	Open Source Information System
PDM	physical data model
PGM	precision guided munition(s)
PKI	Public Key Infrastructure
Plt	platoon
PMAA	Production Management Alternative Architecture
POM	Program Objective Memorandum Architecture
PPBS	Planning, Programming, and Budgeting System

PUMA	Precision Undersea Mapping
RAGE	Real-time Automated Geo-registration for Exploitation
RAS	Requirements Analysis System
R&D	research and development
RBM	Receiver Broadcast Manager
RELROK	Releasable to Republic of Korea
Rgmt	regiment
RPF	Raster Product Format
RRS	Remote Replication System
S	Secret
S57	IHO Transfer Standard for Digital Hydrographic Data
SAM	surface-to-air missile
SATCOM	satellite communication(s)
SCOTS	standards-based, commercial off-the-shelf
SEN	Small Extension Node of Mobile Subscriber Equipment (MSE)
SIAP	Single Integrated Air Picture
SIGINT	signals intelligence
SIPRNET	Secret Internet Protocol Router Network
SON	safety of navigation
SRDB	Shared Requirements Data Base
SRTM	Shuttle Radar Topography Mission
TBM	theater ballistic missile
TGIL	Tactical Geospatial Information Library
TIP	Theater Injection Point
TOD	Tactical Ocean Data
TS	Top Secret
UCDM	USIGS Conceptual Data Model
UEDM	USIGS Enterprise Data Model
UN	United Nations
US	United States (of America)
USIGS™	United States Imagery and Geospatial Information Service™
VDU	VPF Digital Update
VMap1	Vector Map Level 1
VO	vertical obstruction
VOD	Vertical Obstruction Data
VPF	Vector Product Format
VPU	Vector Product Update
VVOD	Vector Vertical Obstruction File
WAS	wide area surveillance
WGS84	World Geodetic System 1984

Definitions of Key Terms

bare earth elevation data—elevation data that has been brought to ground level, taking out the effects of vegetation and manmade features.

Big Idea—NIMA concept for collaborative "one-touch" information maintenance, enhanced access to and navigation in a maintained representation of the Earth, and tool sharing.

common operational picture (COP)—the COP is a graphical display of friendly, hostile, and neutral units, assets, overlays, and/or tracks pertinent to operations, and is a key tool for commanders in planning and conducting joint operations. The COP may include relevant information from the tactical to the strategic level of command. Source of definition for this term is JCS Joint Pub 3-35, Joint Deployment and Redeployment Operations, dated 7 September 1999. COP should not be confused with CROP, which is used exclusively in this document.

Common Relevant Operational Picture (CROP)—a presentation of timely, fused, accurate, assured, and relevant information that can be tailored to meet the requirements of the joint force and is common to every organization and individual involved in a joint operation. It is sufficiently robust and adaptable to accommodate exchange of information with non-DoD organizations (including governmental, international, and private) and coalition forces. The CROP is a key element of information superiority and battlespace awareness. Source of this term is the Chairman, Joint Chiefs of Staff, Joint Vision 2020 document, undated.

common tactical picture—a presentation of timely, fused, accurate, assured, and relevant information at the level of components of Commands or Joint Task Forces.

conceptual data model—a precisely defined, functionally neutral, normalized definition of the data needed to satisfy the combined information requirements of an enterprise.

conflate—to identify, resolve, and merge different renditions in spatial datasets of what is actually the same entity.

customer—a primary recipient of an enterprise's products and services.

data object—any piece of uniquely identifiable data. Data objects will be stored in electronic libraries and registered, wherever possible, to the common geometry of the geospatial framework. Objects include necessary attribution, logical interrelationships, and associated metadata.

data sharing environment—an infosphere enabled by metadata management, shared data access, physical data management, and shared data.

demands—requisitions or requests for products or services that are directly available for satisfaction. Demands represent the closest part of the requirements process to the customer of the data or products.

densify—add content to create greater detail in a dataset; for densification of foundation data to create mission-specific data sets, there is an implication that original content is of sufficient quality to be supplemented, rather than replaced, by content with greater detail.

e-business—electronic business; the use of the Internet to create new business models (new ways of serving customers, new ways of generating profits).

Focus Program--- a joint government/industry airfield image understanding and change detection initiative.

foundation-based operations—the use of foundation data and its further densifications into mission-specific data sets (MSDS) as digital sources for visualization and analysis as well as for hardcopy printing, as the geospatial content of the common relevant operational picture (CROP), and as content for any required high-volume printing.

foundation data--- an assemblage of geospatial data that is collected near worldwide, independent of missions, that is relatively stable, accurate, and tied to a common geometry. Foundation data consists of controlled and orthorectified imagery, elevation data, bathymetry, vector features including air and nautical navigation safety, and other data such as gravity and magnetics.

Foundation Feature Data–- an agreed-to set of coverages, features and attributes that range in density from what would normally be found on a 1:100K Topographic Line Map in areas of military interest (e.g., urban areas) to that found on a 1:250K Joint Operations Graphic in open terrain.

Functional Manager—an assigned responsibility in DoD and the IC for providing periodic high-level guidance to a functional community regarding programs, initiatives, and activities, allowing program managers in that community to more accurately prepare IPOM and POM submissions.

fusion—bringing data from different sources into alliance through a formal framework such as spatial referencing or logical connection; may or may not involve conflation; fusion is the broader of the two terms.

gateway—a website that may or may not provide services in addition to content.

geospatial framework—a consistent view of geospatial information and supporting services that provides a coherent frame of reference to support the formation of an integrated view of the mission space.

geospatial information—any information about the earth that has associated with it some contextual, spatial, and temporal reference; more specifically, it is a collection of precise spatially co-referenced information about the earth, with temporal tags, arranged in a coherent structure and format.

geospatial information infrastructure (GII)—the collection of people, doctrine, policies, architectures, standards, and technologies necessary to create, maintain, and utilize geospatial information and services in the context of a geospatial framework.

global geospatial readiness— the trusted geospatial information, services, and digital infrastructure that will be in place to support national strategic interests, operational planning, safety of navigation, and accurate positioning of other information to specific locations on the earth.

global geospatial mission responsiveness— the capability and capacity needed to produce and deliver the right geospatial information, at the right time, to the right place.

imagery—photographic or electronic representations of the earth from above.

imagery intelligence—intelligence derived from the exploitation of collection by visual photography, infrared sensors, lasers, electro-optics, and radar sensors such as synthetic aperture radar wherein images of objects are reproduced optically or electronically on film, electronic display devices, or other media.

information coproduction—the generation, processing, and reporting of data by an approved facility, organization, or foreign government with authority to apply data certification; such coproduction is normally limited to an approved set of data generation processes and products.

information need—a recognized gap in customers' knowledge or information holdings.

information production—the generation, processing, and reporting of data within an enterprise, using controls established by the enterprise to assure quality.

information production support data—all data required by USIGS to generate the imagery, imagery intelligence, and geospatial information of interest. Information production support data includes, but is not limited to, collection sensor calibration data, models (e.g., data elevation models, surface runoff and erosion models, flooding and stream loading models), exploitation/mensuration support data, and sensor-specific processing software models.

information requirement—a formal statement of all or a portion of an information need in a form that can be allocated to an organizational component for action. Information requirements include collection, processing, generation, search, retrieval, storage, and delivery requirements.

information transaction—all or part of the satisfaction of an information requirement. For example, USIGS information transactions include: the collection of imagery data, feature extraction from imagery, and transmission of an information view over a communications path.

information view—a presentation or display of data objects.

interoperability—the capability of people, organizations, and equipment to operate effectively together. Interoperability allows diverse systems made by different vendors to communicate with each other. Interoperability implies compatibility among systems at specified levels of interaction. This compatibility is achieved through specifications for the interfaces between systems.

metadata—data about data; graphical or textual information about the content, quality, condition, origins, and characteristics of data.

metric—a composite of meaningful measures taken over time that communicate important information about processes, performance, or product quality.

Mission-Specific Data Set—consists of intensified foundation data encompassing greater detail (density and resolution) or additional features and/or attributes to meet specific mission requirements. May also include the "tailoring" or analysis of available geospatial information to support the information needs of a decision maker.

needs—unconstrained customer shortfalls; needs are potential future requirements. Included in this category are the geospatial needs for emerging weapons systems.

NIMA Integrated Information Library (NIIL)—the future object-based one-touch capture and maintenance environment for geospatial content and spatially-referenced intelligence.

OpenGIS™ Consortium—a private-sector non-profit organization promoting interoperability in geoprocessing

orthonormalization—removal of distortions of imagery through mathematical processes that compensate for lateral displacement due to terrain relief by computing predicted displacement from a pre-existing digital elevation model.

orthorectification—removal of all distortions in imagery, to include lateral displacement due to terrain relief, usually through stereo photogrammetric processes, to create a photographic image with map-like accuracy and scale.

Pathfinder Program—an annual process under NIMA leadership to identify and evaluate technologies to assist imagery and geospatial analysts.

portal—a web site that offers a great amount of content and services related to a specific subject area or to a range of subject areas. When considered within USIGS, this includes the subject areas of geospatial information, imagery, and imagery intelligence.

products—the physical output of an organization intended to satisfy the needs of one or more of its customers. This implies routine production of the same information or type of information with a common look and feel for customers.

raster—a data form in which geographic features are represented as grid cells in a matrix, with each cell recording some sort of information averaged over the cell's area.

recipe—a script and list of ingredients for creating an information view.

requirements—verifiable, constrained customer shortfalls; in the geospatial context, requirements may be for capabilities, product types, or area coverage. The geospatial area requirements system drives the production of the items that, for example, populate the database for the Gateway and the shelves at the Defense Supply Center, Richmond (for DLA). Chairman, JCS Instruction (CJCSI) 3901.01 and Joint Pub 2-03 provide guidance on how to request, prioritize, and manage risk for requirements for geospatial information.

scale—the ratio of distances represented on a map or photograph to their true lengths on the Earth's surface. Scale always refers to linear horizontal distances, and not to measurements of area or elevation. For aerial photographs, small scale is 1:40,000 and smaller, medium scale is 1:10,000 to 1:40,000, and large scale is 1:500 to 1:10,000. For military maps and charts, small scale is 1:600,000 and smaller (with the standard at 1:1,000,000, for use in general planning and strategic studies at high echelons), medium scale is 1:600,000 to 1:75,000 (with the standard at 1:250,000, for use in planning operations, including movement and concentration of troops and supplies), and large scale is 1:75,000 and larger (with the standard at 1:50,000, for use in meeting the tactical, technical, and administrative needs of field units). For civilian maps, small scale is 1:1,000,000 and smaller, medium scale is 1:100,000 to 1:1,000,000, and large scale is greater than 1:100,000.

service provider—in the geospatial context, a role that includes information brokering (negotiating agreements between those with geospatial information and the organizations agreeing to make that information available across the web via smart portal technologies), managing a clearinghouse of trusted exploitation tools, and providing tailored analyses and visualizations to customers with limited exploitation assets, time, or expertise.

smart portals—Powerful, interactive network communications channels that are driven by profiles, obtain content and services from sources, and bring it to customers.

tailoring—modifying a process, standard, or procedure to better match process or product requirements.

thin client—a low-cost approach to providing network services in which clients pull from another central processing unit (CPU). All instructions and sessions come directly from a central, secure server, with each thin client operating independently from the other thin clients.

topology—a list of explicit relationships between geographic features that remain invariant when the geometric forms are deformed or transformed by bending, stretching, and shrinking.

trusted geospatial information—geospatial information of known quality, currency, accuracy, and lineage.

USIGS—the United States Imagery and Geospatial Information Service; the extensive network of organizations, people, leadership, training, doctrine, standards, procedures, hardware and software that provides our nation with fused imagery, imagery intelligence, and geospatial information needed to achieve information superiority.

USIGS components—the policies, doctrine, training, people, architectures, systems, information, products, and services that together constitute the USIGS.

value adding—work performed subsequent to the finished production or generation of geospatial information to increase its value. This may include, but is not limited to, data verification, correction, update, densification, supplementation with additional categories of geospatial information, reformatting, fusing, resampling, or linking to related content in other databases. Value-added geospatial information may not meet the accuracy and quality standards associated with foundation or mission-specific data.

vector—a data form in which spatial features are represented by primitive geometric entities such as points, lines, and polygons.

VOLPE---a format for Instrument Approach Procedures developed by the VOLPE Center of the US Department of Transportation.

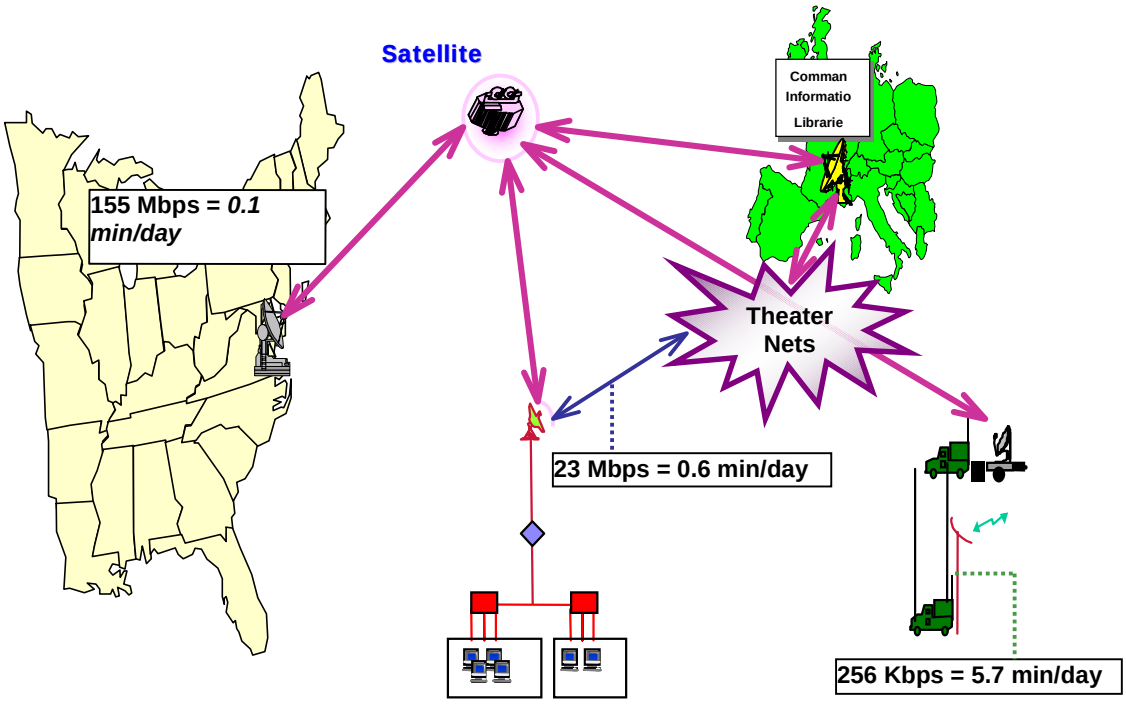
Appendix D: Responsiveness Strategy and Bandwidth

This appendix illustrates how geospatial information is delivered in 2010 while minimizing the impact on customers' communication bandwidth using the responsiveness strategy.

The responsiveness strategy provides additional high-resolution geospatial information to foundation data already on hand. The capability to intensify FD and provide the additional information to existing data sets significantly reduces the bandwidth required for geospatial data.

Satellite broadcast capability is expected to play a key role in providing geospatial information to the warfighter. Tactical levels within the command echelons, where communication bandwidth is expected to be low, can receive update information through existing networks to lessen the load on communications. Updated information may take several forms, to include a simple view using web formats and VPF Digital Update (VDU) or VDU-like updates. This capability is not a one-way street. The same foundation-based operational processes that provide updates to FD can be used with smart push/pull applications to “give –back” geospatial information to the geospatial data providers. This ensures value-added information has a way to get back to the USIGS data holdings, increasing the information available to future warfighters and crisis managers.

Using IGCRD requirements, the following picture illustrates the probable impact in 2010 of adding geospatial information to the communication grid already planned.



Geospatial Information Volumes: 2010

Communication times are based on a 30-day requirement for 300km^2 coverage. This geospatial information is delivered to the customer's agreed-upon line of demarcation. This line may be at the NIMA portal where information can be accessed directly, while other customers will require data to be available to them electronically across a satellite broadcast system or network. Using smart push/pull applications, this geospatial information will be available for use by the customer as determined by the customer's own doctrine. This allows customers to decide, based on their operational plans and system architectures, the best method to receive geospatial information and then share it with other customers using already-established information systems.

How Rates Were Calculated

Some, if not most, of the data sets and views expected to be available in 2010 do not exist today. The file sizes of 2010 data sets have been estimated using comparable products of today. Data set updates are expected to be 15%, on average, of the size of the data sets they update. As the responsiveness strategy is further developed, file sizes will likely decrease as architectures take advantage of foundation-based operations but the demand for files will increase as geospatial information is integrated into more decision cycles.

Data Set	Data Coverage	Estimated File Size (MB)	Estimated percent of IGCRD coverage required	# of IGCRD 300km x 300km Requirement data sets	Resulting File Size for Full Coverage (MB)	30 Days @155 Mb/s in sec/day	30 Days @ 23 Mb/s in sec/day	30 Days @ 256 Kb/s in sec/day
Ocean MSDS (New)	15' x 15'	20	10%	10	200	**0.34**	**2.32**	
Ocean MSDS **(Update)**	15' x 15'	3	5%	5	15	**0.03**	**0.17**	**15.63**
Land MSDS (New)	15' x 15'	4.5	60%	60	270	**0.46**	**3.13**	
Land MSDS **(Update)**	15' x 15'	0.675	20%	20	13.5	**0.02**	**0.16**	**14.06**
Aero MSDS (New)	15' x 15'	6	90%	90	540	**0.93**	**6.26**	
Aero MSDS **(Update)**	15' x 15'	0.9	10%	10	9	**0.02**	**0.10**	**9.38**
Aero MSDS **(Airfield update)**	NA	0.1	5%	3	0.3	**0.00**	**0.00**	**0.31**
Urban MSDS (New)	3.75' x 3.75'	350	10%	40	14000	**24.09**	**162.32**	
Urban MSDS **(Update)**	3.75' x 3.75'	52.5	10%	40	2100	**3.61**	**24.35**	**2187.50**
Littoral MSDS (New)	3.75' x 3.75'	4.5	5%	20	90	**0.15**	**1.04**	
Littoral MSDS **(Update)**	3.75' x 3.75'	0.675	5%	20	13.5	**0.02**	**0.16**	**14.06**
Total data sets				**318**				
Total Communication Time (minutes per day)						**0.495**	**3.334**	**37.349**

155 Mb/s: This bandwidth represents the backbone communications grid for the customer. It will carry all information necessary for successful execution of the mission.

23 Mb/s: This bandwidth represents the secondary communications grid for the customer, able to carry geospatial information with limited impact to operations.

256 Kb/s: This bandwidth represents the 'last tactical mile' to the customer, able to carry geospatial information updates with limited impact to operations.

Appendix E: Roadmap for USIGS Geospatial Implementation

Section	Program	OPR	Initiative	Near-Term FY01-FY03	Mid-Term FY04-FY05	Long-Term FY06-07
3 Ensuring Success						
3.1	Funded	NIMA PCO	Develop supportive policy and resource environment	• Communicate and coordinate with NIMA customers to support transition to foundation-based operations		
3.2	Funded	NIMA DO	Build alliances with national and international partners	• Promote USIGS concepts and work toward adoption of open standards that support sharing and interoperability of geospatial information		
3.3	Funded	NIMA DO/AT	Build alliances with industry	• Ensure consistent and stable contract programs and partnership mechanisms		
3.4	Funded	NIMA NP/CIO	Facilitate sharing of imagery and geospatial information	• Work with ASD(C3I) and DoD Chief Information Officer (CIO) to develop solutions and make appropriate policy and procedure changes to facilitate sharing of imagery and geospatial information		
3.5.1	Funded	NIMA PCO/CIO	Establish measures of success to improve customer satisfaction	• Quantify support to readiness provided by NIMA's tailored geospatial information products and services		
3.5.2	Partially Funded	NIMA PCO	Quantify geospatial information utility	• Develop and implement metrics to quantify information utility based on multiple criteria (e.g., accuracy, currency, density, coverage, intended use) – – – →		
3.5.3	Funded	NIMA PCO	Global Readiness	• Develop and implement measure of global readiness based on the utility provided by the components of foundation data and available mission-specific data sets		
3.5.4	Funded	NIMA PCO	Safety of Navigation	• Review and update (as required) metrics that measure the accuracy and timeliness of aeronautical and maritime safety of navigation update information		
3.5.5	Funded	NIMA PCO	Mission Readiness	• Develop and implement metrics for mission readiness based on foundation-based operations and the readiness and responsiveness strategy		
3.5.6	Funded	NIMA CIO/AT/IS	USIGS Performance	• Develop and track critical capability and performance measures		
3.5.7	Partially Funded	NIMA DO/AT	Transition to open standards	• Adopt proven SCOTS-based applications, services and open standards for interfaces and geospatial information exchange – – – –	– – – – →	
3.5.8a	Partially Funded	NIMA DO	Reduce the cost of foundation-based operations through information acquisition	• Prototype and implement processes to generate FFD and MSDS from non-traditional sources and acquire commercial data to populate the foundation – – – –	– – – –	– – – – →

Note: Arrow shows additional funding required over the indicated period – – – – – – – – →

Section	Program	OPR	Initiative	Near-Term FY01-FY03	Mid-Term FY04-FY05	Long-Term FY06-07
3.5.8b	Unfunded	NIMA AT/IS	Implement tools to support knowledge management and data mining for information acquisition	• Tools are required to manage potential source information and to facilitate discovery and acquisition of critical sources to meet high priority requirements →		
3.5.9	Partially Funded	NIMA AT/IS	Leverage e-business solutions to improve customer access	• Evaluate performance improvements that may be achieved through web-based technology insertion →		
3.5.10	Funded	NIMA PCO/DO	Exercise and refine the Geospatial Implementation Master Plan through scheduled Exercises, Experiments and Demonstrations	• Collect metrics, develop lessons learned, and plot course corrections to the Geospatial Implementation Master Plan		

4 Requirements Management

4.1.1	Funded	NIMA PCO	Implement an information-based requirements process	• Employ intended use codes in the Requirements Analysis System (RAS)		
4.1.2	Funded	NIMA PCO	Rebaseline the geospatial requirements deck for foundation-based operations	• Review OPLANs, CONPLANs and Functional Plans • Assess readiness requirements versus responsiveness requirements		
4.1.3	Funded	NIMA DO/AT	Link requirements to production through the Production Management Alternative Architecture (PMAA)	• Enhance PMAA to address foundation data and MSDS requirements		
4.1.4	Unfunded	NIMA PCO/IS	Provide online customer access and manage requirements for tailored information		• Enhance the combined PMAA/RAS to provide customers with online access through the Gateway or Portal →	
4.1.5	Partially Funded	NIMA PCO/AT	Develop an integrated information requirements management capability		• NIMA participation in SRDB is funded • Begin replacement of PMAA/RAS →	
4.2.1	Funded	NIMA PCO	Conduct timely information-based readiness reviews	• Work with the Joint Staff to redefine readiness in terms of foundation-based operations		
4.2.2	Funded	NIMA PCO/DO	Allocate production resources to optimize geospatial readiness		• Assign resources based on regional area, readiness, and utility of the information to be added to the shared geospatial framework	

5 Standards Selection/Development and Implementation

5.1.1	Funded	NIMA DO/AT	USIGS Conceptual Data Model (UCDM) for geospatial information	• Creates a uniform set of data definitions and relationships		

Note: Arrow shows additional funding required over the indicated period →

Section	Program	OPR	Initiative	Near-Term FY01-FY03	Mid-Term FY04-FY05	Long-Term FY06-07
5.1.2a	Funded	NIMA DO/AT	USIGS Enterprise Data Model (UEDM) integrates imagery, imagery intelligence, and geospatial information		• Provides the framework for the object-based environment planned in the NIMA Integrated Information Library (NIIL)	
5.1.2b	Unfunded	NIMA AT	Data architecture development for the NIIL, and implementation of a data model repository for internal and external developer access		• Supports the development of logical and physical data model implementations based on the UCDM/UEDM →	
5.1.3	Partially Funded	NIMA DO/IS	Imagery and geospatial information exchange standards	• Develop Data Content Specifications that are independent of the required exchange format →		
5.1.4	Unfunded	NIMA DO	Global vertical frame of reference for elevation and depth information in NIMA systems	• Provides a seamless vertical frame of reference for the littoral environment →		
5.1.5a	Unfunded	NIMA AT	Interoperability of NIMA information in the Common Relevant Operational Picture (CROP)		• Identifies and implements interoperable interfaces, and prototypes data integration →	
5.1.5b	Unfunded	NIMA DO	Standards for geo-linking across information domains in the CROP			• Integrate information from other databases →
5.2.1	Funded	NIMA PCO/DO	Foundation data and mission-specific data set Data Content Specifications (DCSs)	• Defines the content of FFD and MSDS for air, land, urban, littoral, and ocean intended uses	• Data Content Specifications support exchange in multiple formats and the transition to open-exchange standards	
5.2.2	Funded	NIMA DO/IS	Presentation and Symbolization Specifications		• Supports prescribed “views” of geospatial information and the development of tailored “views”	

6 Information Management

6.1.1	Funded	NIMA DO/AT/IS	NIMA Geospatial Storage System (NGSS) and Digital Products Data Warehouse (DPDW)	• Provides file-based storage for geospatial information		
6.1.2	Partially Funded	NIMA DO/IS	Migration of selected digital product files into a consolidated file-based storage architecture	• Implement standard metadata for geospatial information files →		
6.1.3	Unfunded	NIMA AT/IS	Enhance consolidated file storage architecture to store and manage new geospatial information files		• Provides storage for Land-Use/Land-Cover data, SRTM data, and new processed acoustic imagery →	

Note: Arrow shows additional funding required over the indicated period →

Section	Program	OPR	Initiative	Near-Term FY01-FY03	Mid-Term FY04-FY05	Long-Term FY06-07
6.2.1	Partially Funded	NIMA AT/IS	Feature-Level Database (FLDB) development	• Additional funding is required in FY03 to accelerate FLDB • Provides the mid-term solution for the NIMA geospatial information library →		
6.2.2	Funded	NIMA DO	Data authority determination for migration and maintenance		• Reduces or eliminates redundancy in production databases • Supports future transition to "One Touch Maintenance" environment of the NIIL	
6.2.3	Unfunded	NIMA DO/AT/IS	Migration of existing feature information into the FLDB		• Appropriate files from NGSS and DPDW will be loaded to support conflation of geospatial features →	
6.2.4a	Unfunded	NIMA AT	Linking imagery analysis and geospatial information		• Implements interfaces between FLDB/NIIL and selected imagery analysis systems →	
6.2.4b	Unfunded	NIMA AT	Implement the USIGS Enterprise Data Model (UEDM) on geospatial information production systems and libraries		• Enables the exploitation of imagery analysis information for FFD and MSDS production and to support analytical services →	
6.3.1	Funded	NIMA AT	"One Touch Maintenance" environment prototype	• Supports the development of interfaces for loading data from the FLDB into the future NIIL		
6.3.2	Unfunded	NIMA AT	NIMA Integrated Information Library (NIIL)		• Begins development of long-term solution for the NIMA geospatial information library →	
6.4.1	Funded	NIMA DO/AT/IS	Sustainment of aeronautical production systems	• Sustains the Aeronautical Migration System (AMS) and Aeronautical Digital Data Environment (ADDE)		
6.4.2a	Funded	NIMA AT/IS	Migration of aeronautical production databases to the FLDB and/or NIIL		• Migrates the ADDE into the integrated information environment	
6.4.2b	Funded	NIMA AT/IS	Recapitalize Aeronautical Migration System (AMS) workstations		• Upgrade and interface to the FLDB	
6.4.3a	Funded	NIMA DO/AT	Development of the FLIP Chart Production Environment (FCPE)	• Supports Digital-to-Plate printing of Enroute Charts and Instrument Approach Procedures		
6.4.3b	Funded	NIMA DO	Support VOLPE format Instrument Approach Procedures until they can be generated from FCPE	• Supports near-term manual production		

Note: Arrow shows additional funding required over the indicated period →

Section	Program	OPR	Initiative	Near-Term FY01-FY03	Mid-Term FY04-FY05	Long-Term FY06-07
6.4.4	Funded	NIMA DO/AT	Digital Aeronautical Flight Information File (DAFIF) updates	• Required updates correspond to the upgrade schedule for DoD flight management and mission planning systems		
6.4.5	Unfunded	NIMA DO	Digital Vertical Obstruction File (DVOF) conversion to VPF format to provide Vector Vertical Obstruction Data (VVOD)	• Meets Service requirements for VOD in VPF →		
6.4.6	Unfunded	NIMA DO	Implement Aeronautical Source Environment to process digital safety of navigation source data	• Enables NIMA to directly ingest digital source data provided in Aeronautical Information Exchange Model (AIXM) format →		
6.4.7a	Partially Funded	NIMA IS	DCAFE sustainment to support DNC and TOD production	• Sustains DCAFE until replacement with IEC workstations →		
6.4.7b	Funded	NIMA IS	CNO Special production of TOD	• Sustains and enhances production system to meet Navy requirements		
6.4.7c	Funded	NIMA AT	TOD software development	• Supports development of software to produce TOD 3, TOD 4, and TOD 5 for Navy's New Attack Submarine		
6.4.7d	Partially Funded	NIMA IS	Navigation Safety System (NSS)	• Sustains NSS until functionality can be provided by the Nautical Database Maintenance Environment (NDME) →		
6.4.7e	Funded	NIMA IS	Hydrographic Source Assessment System (HYSAS)	• Sustains HYSAS until functionality can be provided by the NDME		
6.4.8a	Partially Funded	NIMA AT	HydroVision NIMA Production Cell (NPC) object-oriented development	• Near-term funding required for development and sustainment. Current program provides mid-term funding →		
6.4.8b	Unfunded	NIMA DO	Load DNC files into the HydroVision NPC object-oriented database	• Supports continuous maintenance of DNC files to meet operational Navy requirements →		
6.4.8c	Unfunded	NIMA DO/AT	Procure additional licenses for the HydroVision NPC object-oriented database	• Supports maintenance of DNC files to meet operational Navy requirements →		
6.4.9	Unfunded	NIMA DO/AT	Development of the Nautical Database Maintenance Environment (NDME) - provides an operational model for development of the NIIL		• Upgrades maritime safety and hydrographic capabilities for source data processing and information finishing →	
6.4.10	Unfunded	NIMA DO/AT	Nautical data format conversions	• Converts DNC VPF files to and from IHO S57		

Note: Arrow shows additional funding required over the indicated period →

Section	Program	OPR	Initiative	Near-Term FY01-FY03	Mid-Term FY04-FY05	Long-Term FY06-07
				format →		
6.4.11	Unfunded	NIMA AT	Implement capability to process Precision Undersea Mapping (PUMA) acoustic imagery	• Provides 3-D mapping of the ocean floor within and beyond the littoral zone →		
6.4.12	Funded	NIMA DO/AT	Sustainment and migration of Geodesy and Geophysics (G&G) production systems	• Sustains G&G systems	• Migrates G&G systems into the FLDB and/or NIIL as appropriate	
7.1 Information Acquisition/Production – Exploitation Ready Information						
7.1.1	Partially Funded	NIMA DO/AT	Prototype automated processing for geospatial information generation		• Prototypes the capability to automatically generate DEM, CIB, DPPDB; perform triangulation, change detection, and feature extraction such as vertical obstruction data (VOD) →	
7.1.2	Unfunded	NIMA DO/AT	Bare earth elevation data		• Supports prototyping and possible implementation of a "bare earth" processing capability →	
7.1.3	Unfunded	NIMA DO/AT/IS	3-D site models		• Provides regional teams with the operational capability to generate 3-D site models →	
7.2 Information Acquisition/Production and Maintenance Strategy						
7.2.1	Funded	NIMA DO	Acquisition/Production Strategy	• Exploit data from alternative sources, establish new acquisition methods • Only build geospatial information that cannot be obtained from alternative sources		
7.2.2	Funded	NIMA DO	Maintenance Strategy	• Exploit change detection analysis to initiate maintenance actions		
7.3 Information Acquisition/Production – Safety of Navigation						
7.3.1a	Funded	NIMA DO	Digital Nautical Chart (DNC) production and maintenance	• Required to support scheduled deployment of operational Navy electronic navigation systems		
7.3.1b	Funded	NIMA DO	Tactical Ocean Data (TOD) production and maintenance	• Supports operational Navy requirements for TOD 0, TOD1, and TOD 2		
7.3.2	Unfunded	NIMA DO	Digital Vertical Obstruction File (DVOF)/Chart Update Manual (CHUM) production and maintenance	• Works off maintenance backlog to provide vertical obstruction data →		
7.3.3	Unfunded	NIMA DO	Outsource aeronautical library functions	• Manages the receipt, distribution, and archive of source information →		

Note: Arrow shows additional funding required over the indicated period →

Section	Program	OPR	Initiative	Near-Term FY01-FY03	Mid-Term FY04-FY05	Long-Term FY06-07
7.3.4	Unfunded	NIMA DO/AT	Automated Airfield Change Detection. Fund continuation of the Focus program	• Processes airfield imagery to flag change areas for analyst review →		
7.3.5	Unfunded	NIMA AT	Vertical obstruction detection	• Uses automated feature extraction software to aid in collecting candidate vertical obstructions →		
7.3.6	Unfunded	NIMA DO	Process Shuttle Radar Topography Mission (SRTM) "spike file"	• Provides a near-global coverage of unvalidated vertical obstructions to identify the location of possible hazards to aeronautical safety of navigation →		
7.3.7a	Partially Funded	NIMA DO	Airfield surveys – GPS survey	• Supports collection of accurate ground points using GPS – to improve the safety of airfield navigation; updates are required every 5 years →		
7.3.7b	Unfunded	NIMA DO	Airfield surveys – Photogrammetric extraction of terrain and vertical obstructions	• Supports development of 3-D approach models and reduces dependence on ground-based navigational aids →		

7.4 Information Acquisition/Production – Foundation Data (FD)

7.4.1	Partially Funded	NIMA DO	Foundation Feature Data (FFD)	• Maintains a core NIMA workforce capability for FFD production • Increases the outsourcing program to achieve total coverage of approximately 10,700 one degree by one degree latitude/longitude cells by the end of 2010 →		
7.4.2	Unfunded	NIMA DO/AT	FFD delineation of drainage and water bodies	• Procures near-global soils database and prototypes methods to derive drainage coverage →		
7.4.3	Unfunded	NIMA DO	Aeronautical flight and safety of navigation information integration with FFD	• Integrates planning level information with FFD to support "views" similar to the content of a Joint Operations Graphic-Air or an Air Target Chart →		
7.4.4	Unfunded	NIMA DO	Seamless land/sea information in littoral regions of FFD		• Integrates DNC and hydrographic information with terrain and near shore information in FFD →	
7.4.5	Partially Funded	NIMA DO	Controlled Image Base (CIB)	• Completes near-global CIB coverage by the end of 2005 →		
7.4.6	Partially Funded	NIMA DO	Digital Point Positioning Database (DPPDB)	• Completes coverage over approximately 7100 cells by the end of 2005 →		
7.4.7	Funded	NIMA DO	Geopositioning program	• Makes up the backlog needed to support other acquisition programs (FFD, CIB, etc.)		

Note: Arrow shows additional funding required over the indicated period →

Section	Program	OPR	Initiative	Near-Term FY01-FY03	Mid-Term FY04-FY05	Long-Term FY06-07
7.4.8	Partially Funded	NIMA DO	Gravity and gravity gradiometry data	• Provides additional collection in data-sparse areas to support inertial navigation systems and smart weapons systems →		
7.4.9	Partially Funded	NIMA DO	Satellite geodesy	• Supports near-real-time navigation and post-analysis of precise navigation systems that rely on WGS-84 →		
7.4.10a	Unfunded	NIMA DO	Weapons system support modernization	• Supports maintenance and improvement of WGS-84 for weapons system navigation and targeting →		
7.4.10b	Unfunded	NIMA DO	Outsource weapons system testing range surveys – currently supported by NIMA personnel	• Supports testing of weapons system navigation and targeting accuracy →		

7.5 Information Acquisition/Production – Mission-Specific Data Sets (MSDS)

7.5.1	Funded	NIMA DO	NIMA's core workforce for the "readiness and responsiveness" strategy	• Identifies a core workforce capability available to support crisis response • When not engaged in a crisis, the workforce supports acquisition/production of readiness MSDS and other prioritized requirements for geospatial information		
7.5.2	Unfunded	NIMA DO	Contractor augmentation to support NIMA's "readiness and responsiveness" strategy	• Provides additional contractor support to achieve a core workforce capable of meeting the requirements for readiness and responsiveness in the IGCRD →		
7.5.3	Unfunded	NIMA DO	Acquisition of high-resolution geospatial information for MSDS	• Funds the acquisition of alternative source data for MSDS →		
7.5.4	Unfunded	NIMA DO	Acquisition of high-resolution data to support Military Operations in Urbanized Terrain (MOUT)		• Funds the acquisition of urban infrastructure information (water, power, sewer, communications, etc.) for MOUT →	
7.5.5	Unfunded	NIMA DO	Process acoustic imagery collected from the Precision Undersea Mapping (PUMA) sensor system	• Provides 3-D mapping of the ocean floor within and beyond the littoral zone →		

7.6 Information Acquisition/Production – Analytical Services

7.6.1	Funded	NIMA PCO	Forward deployed support	• Continues to provide Technical Representatives, Customer Support Response Teams (CSRTs), and Contingency Response Teams (CRTs)
7.6.2	Funded	NIMA DO	Reach-back support	• Maintains the capability to respond to requirements for specialized geospatial information and analysis

8 Exploitation Capabilities

Note: Arrow shows additional funding required over the indicated period →

Section	Program	OPR	Initiative	Near-Term FY01-FY03	Mid-Term FY04-FY05	Long-Term FY06-07
8.1	Partially Funded	NIMA AT/IS	Integrated Exploitation Capability (IEC) workstations – phases in IEC replacements for legacy workstations	• Funding accelerates the replacement schedule for legacy workstations →		
8.2	Unfunded	NIMA DO/AT	Upgrade IEC workstations for spectral image processing		• Provides additional memory on a subset of IA and GA workstations →	
8.3a	Unfunded	NIMA AT	Integrate enhanced software applications for geospatial information processing and finishing and for extraction from a variety of non-imagery sources		• Technology insertion for advanced exploitation and production tools based on R&D successes →	
8.3b	Funded	NIMA AT	Integrate enhanced software applications to upgrade the processing of spectral and radar imagery		• Technology insertion for advanced exploitation tools based on R&D successes	
8.3c	Unfunded	NIMA AT	Integrate enhanced exploitation software to upgrade the processing of electro-optical and infrared imagery		• Technology insertion for advanced exploitation tools based on R&D successes →	

9 User Information Access, Discovery, and Retrieval

9.1.1a	Partially Funded	NIMA IS	User access to existing NIMA holdings via the Gateway	• Enhances Gateway to provide access to additional NIMA data sets →		
9.1.1b	Unfunded	NIMA IS	Enhance the storage capability of the Gateway to support geospatial information dissemination and future portal technology development	• Recapitalizes and expands storage to enable the Gateway to provide a "one-stop" shopping place for NIMA's information holdings →		
9.1.2	Unfunded	NIMA IS	Control/release/license management capability	• Enables the release of copyrighted or otherwise restricted data from the Gateway →		
9.1.3	Unfunded	NIMA IS	Multi-Domain Dissemination System	• Ensures that information is properly reviewed for security and releasability →		
9.1.4	Partially Funded	NIMA IS	Value Adding	• Provides the capability for USIGS organizations to submit geospatial information to NIMA via the Gateway →		
9.2.1	Unfunded	NIMA IS	Public Key Infrastructure (PKI) and customer profiles		• Enables NIMA customers with an Internet connection to access the Gateway →	
9.2.2	Unfunded	NIMA IS	Portal development	• Implements web-based map servers →		
9.2.3	Unfunded	NIMA IS	Portal connectivity and presentation services	• Establishes connectivity between the Gateway and operational external USIGS portals →		

Note: Arrow shows additional funding required over the indicated period →

Section	Program	OPR	Initiative	Near-Term FY01-FY03	Mid-Term FY04-FY05	Long-Term FY06-07
9.3.1	Unfunded	NIMA IS	Dissemination via satellite broadcast	• Establishes connectivity with satellite broadcast manager to disseminate new and updated geospatial information →		
9.3.2a	Funded	NIMA DO/AT	VPF Digital Update (VDU) capability for DNC	• Meets Navy requirement for support to the "Digital Bridge"		
9.3.2b	Unfunded	NIMA AT	Vector database update for FFD and MSDS	• Expands update capability so that it is not tied to the exchange format →		
9.3.3	Funded	NIMA AT	Downstream storage in Command Information Libraries (CIL) and Image Product Libraries (IPL)		• Enhances CILs and IPLs to store and manage geospatial information	
9.3.4	Funded	NIMA AT	Remote Replication System (RRS)	• Sustains CINC and Service RRS in the near-term and plans for the recapitalization of these systems in the mid- to long-term		
9.3.5	Funded	NIMA IS and DLA DAPS	On-Demand Distribution Services	• Prototypes on-demand distribution of geospatial information on paper, DVD, and CD-ROM in the European and Pacific Theaters		
9.3.6	Unfunded	NIMA AT/IS	Future Dissemination Architecture	• Leverages off enhancements in portal technology and e-business services →		
10 End-User Tools and Services						
10.1	Partially Funded	NIMA AT	Commercialization of Joint Mapping Tool Kit (JMTK)	• Implements commercialized version of JMTK for GCCS and related DoD command and control systems. Additional funding accelerates the implementation schedule →		
10.2	Unfunded	NIMA AT	Stand-alone geographic information system (GIS) capability	• Makes commercial GIS licenses available to DoD at reduced cost or supports development of a no-cost alternative GIS capability →		
10.3	Funded	NIMA AT	Geospatial technology assessment	• Expands Pathfinder to assess COTS software against system and technical requirements of acquisition programs		
10.4	Funded	NIMA AT	Software clearinghouse	• Expands Pathfinder to provide software clearinghouse services for GOTS applications and for extensions to GOTS and COTS applications		
11 Education and Training						
11.1	Funded	NIMA HD	Community Geospatial Information Training Council (CGITC)	• Identifies geospatial training requirements associated with implementation of new systems and capabilities		
11.2a	Funded	NIMA HD	Geospatial analysis training	• Supports NIMA workforce requirements and Basic and Advanced Military Occupational Specialty (MOS) qualification training		

Note: Arrow shows additional funding required over the indicated period →

Section	Program	OPR	Initiative	Near-Term FY01-FY03	Mid-Term FY04-FY05	Long-Term FY06-07
11.2a	Funded	NIMA HD	Expansion of geospatial training to address more advanced topics and also to develop computer-based/web-based training programs	• Supports widespread implementation of geospatial education throughout existing military, national and international training institutions		
11.3	Funded	NIMA HD	Foundation-based operations training	• Supports training for NIMA workforce, co-producers, and NIMA customers for the transition to foundation-based operations		

Note: Arrow shows additional funding required over the indicated period